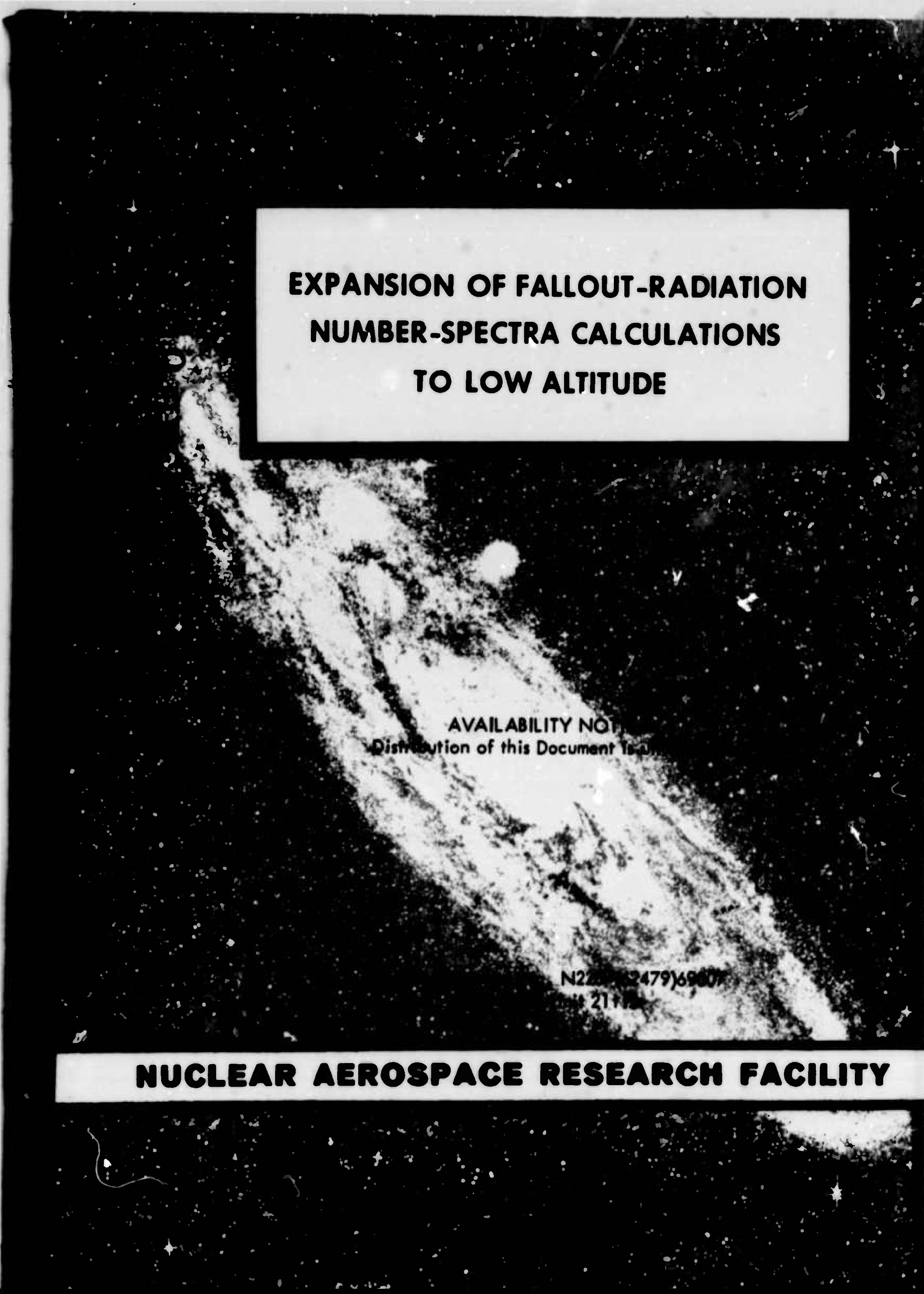
EXPANSION OF FALLOUT-RADIATION NUMBER-SPECTRA CALCULATIONS TO LOW ALTITUDE



AVAILABILITY NO[illegible]
Dist[illegible]tion of this Document is [illegible]

N22[illegible]2479)69[illegible]
[illegible] 21[illegible]

NUCLEAR AEROSPACE RESEARCH FACILITY

BLANK PAGES IN THIS DOCUMENT WERE NOT FILMED

FZK-291
1 July 1966

NUCLEAR AEROSPACE RESEARCH FACILITY

EXPANSION OF FALLOUT-RADIATION NUMBER-SPECTRA CALCULATIONS TO LOW ALTITUDE

by
O. L. McDERMED (principal investigator)
and
T. W. DeVRIES

Sponsored by the
Office of Civil Defense, Office of the Army, through the Civil Defense Technical Group, U.S. Naval Radiological Defense Laboratory.

USNRDL Contract No. N228-(62479)69007
OCD Work Unit 2111I

AVAILABILITY NOTICE
Distribution of this Document is unlimited

OCD REVIEW NOTICE
This report has been reviewed in the Office of Civil Defense and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Office of Civil Defense.

GENERAL DYNAMICS
Fort Worth Division

EXPANSION OF FALLOUT-RADIATION
NUMBER-SPECTRA CALCULATIONS
TO LOW ALTITUDE

SUMMARY

The results of this study extend the work accomplished for the Office of Civil Defense under Contract No. OCD-PS-64-31. The previous work was reported in General Dynamics Fort Worth Division Report FZK-187, Fallout Radiation Energy Distribution as a Function of Altitude. The basic objectives of the present study (FZK-291, 1 July 1966) were to improve the mathematical model and extend to low altitudes the fallout gamma-ray spectra calculations of the previous study.

The mathematical model was revised to permit the Monte Carlo calculation of parametric gamma-ray number spectra at the exact altitudes of 3, 10, 25, 50, 100, and 200 feet. Number spectra were calculated at each of these altitudes for each of 9 input energy groups. The IBM output is in both differential and multigroup form, with the spectra covering an energy range of from 0.04 to 4.00 Mev with 15 output energy groups.

The parametric data were combined according to source fission-product spectra at 11 decay times, from 1.12 hours to 97.3 days. The results are tabulated in differential number form and in multigroup dose-rate form for the 7 altitudes and 11 decay times of the study. These results represent the spectra above a smooth, quasi-infinite ground uniformly covered with fission products (as would result from 10^4 fissions/cm^2 on the ground).

The fallout spectra were compared and analyzed with the aid of a separate computer program. These results are also tabulated. Representative graphs of number and dose-rate spectra are shown. Variations of total dose with altitude are also shown.

Conclusions which resulted from the study are:

1. The fallout fission-product spectrum at 1.12 hr after fission and at a detector altitude of 3 ft is the hardest of all the spectra developed in this study.

2. The spectrum softens with decay time through 2.13 days, becomes harder through 21.1 days, then resumes softening through at least 97.3 days.

3. The spectrum undergoes a constant and rapid softening with increasing detector altitude from 3 to 200 ft. It continues to soften up to about 800 ft.

4. For the idealized smooth-ground geometry of this study, total dose rates decrease rapidly with height above 3 ft. The dose rates at 200 ft are about 25% of the dose rates at 3 ft. The decrease in total dose rate with altitude is nearly independent of decay time for altitudes below 400 ft.

5. The calculational model used in the previous study introduced some error into the low-altitude calculations. The previous results are approximately 15% high at an altitude of 25 ft, with the error reducing to about 4% at an altitude of 200 ft.

A study of ground roughness effects is recommended. Ground roughness effects on spectra, dose vs altitude, and dose vs radius of cleared area should be computed. This would provide a simple method of determining the "effective" ground roughness of any fallout contaminated area and would provide more realistic dose-rate data for application in post-attack situations.

ABSTRACT

Gamma-ray number and dose-rate spectra in the air above a smooth, quasi-infinite ground uniformly covered with fallout fission products are calculated. The spectra are calculated for 11 decay times, from 1.12 hours to 97.3 days, and at 7 altitudes, from 3 ft to 200 ft. The spectra are analyzed for the effects of altitude and decay time on spectral shape, with trends illustrated by computer tabulations and selected graphs.

Results show that the spectra soften with increasing altitude and that they soften with decay time for about 2 days, become slightly harder for about 3 weeks, then resume softening. Reduction of total dose rate with altitude is nearly independent of decay time (below 400 feet). A related study, to determine the effects of ground roughness, is recommended.

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont'd)

LIST OF FIGURES

LIST OF TABLES

I. INTRODUCTION

One possible method of mapping and monitoring large areas for radioactive fallout is by aerial survey. This method requires a knowledge of the resultant time-dependent radiation field and of the response of the detector so that measurements at altitude can be related to dose rates on the ground.

The work documented in this report provides knowledge of the radiation field at low altitudes. It is an extension of work done for the Office of Civil Defense under the recently completed contract, "Fallout Radiation Energy Distribution as a Function of Altitude" (Ref. 1). This extension is identified by two points specified in the scope-of-work statement in the study contract as follows:

The contractor shall

(a) Calculate the gamma-ray number spectra at the exact altitudes of 3, 10, 25, 50, 100, 150, and 200 feet per input gamma ray for each of nine input energy groups (as in Contract No. OCD-PS-64-31) covering the energy range of 0.04 Mev to 4.00 Mev (generating the necessary parametric data).

(b) From the calculations of (a) above and the fallout fission product activity (with volatile products removed as previously calculated and used in the aforementioned contract), the contractor will calculate the gamma-ray number spectra at the same altitudes of (a) above for the same eleven times after detonation as in the previous calculations.

Some of the discussion contained in the previous report (Ref. 1) is repeated herein. This will enable the reader to understand the methods and results of this study without reference to the previous report.

II. CALCULATION OF PARAMETRIC DATA

This section describes the methods used to compute the basic parametric data. As in the previous study, the FMC (Flexible Monte Carlo) computer procedure was used to develop the parametric data. These data are given in multigroup form in Appendix A, and in differential form in Appendix B. Figure 2.1 is a representative plot of the parametric data in differential form, which is the form generally used for descriptive purposes.

The standard deviation of the parametric data for all output energy groups and at all altitudes of the study is estimated to be 10%. The justification for this figure is given in Reference 1.

2.1 Mathematical Model

The study ground rules assume that the fallout fission products are evenly distributed over a smooth ground of infinite extent. Point isotropic detectors were assumed to be located at various altitudes above the fallout plane. The mathematical model and computer code combination applied in this study transformed the problem to one of a point source and semi-infinite detectors. The point source is located on the ground and the semi-infinite detectors at various altitudes above the ground. Cylindrical symmetry was used, and the radii of the semi-infinite detectors were terminated at a radial distance of 100 relaxation lengths* from the point source. At this distance, the maximum probability of escape from the system coincides with the smallest number (10^{-38}) that the IBM 7090 computer is capable of distinguishing from zero.

These transformations made it possible to eliminate the statistical problem of obtaining a representative spatial distribution of source points and allowed the use of an efficient system of statistical estimation. This system utilizes each generated set of collision parameters to its maximum efficiency.

---

*One relaxation length is the thickness of absorber required to reduce the intensity of the incident radiation by a factor of 2.718, or e, the base of the natural logarithms.

Convenience in form of output and the eccentricities of the code dictated the following additional transformations, which are incorporated in the mathematical model shown in Figures 2.2 and 2.3.

1. The linear transformation

$$Z = \frac{h}{3048}$$

where

h = height above ground, in feet

1 cm = 100 ft (3048 cm) in mathematical model

was performed on the air mass below 200 ft. This transformation resulted in

$$\rho_M = 3048\ \rho_A$$

where

ρ_A = density of air

ρ_M = density of air in mathematical model

2. The linear transformation

$$Z = \frac{d}{1000}$$

where

d = depth below the ground in centimeters

was applied to the ground. This resulted in

$$G_M = 1000\ G_g$$

where

G_g = density of ground

G_M = density of ground in the mathematical model

3. A nonlinear transformation was performed on the air above 200 ft; this transformation positioned the remaining air mass thickness (everything above 200 ft) into a model height of 1 cm of constant density.

In the previously approximated semi-infinite model, the calculated average flux over a region was assumed to be equal to the flux at an altitude represented by the midpoint of the region. If the flux within a region is constant, slowly varying, or a linear function of the distance across the region, the flux at the center of the region will always be approximately equal to the average flux over the whole region. However, as shown in Reference 1, the altitude-dependent flux was rapidly varying and nonlinear below an altitude of 100 ft, implying that the averaging technique would yield poor results at low altitudes.

The model used in the present study avoids the nonlinear averaging by inserting void regions 1 cm thick (discontinuities in the mathematical transformation) at the calculational altitudes. Therefore, the calculated average flux in each of these regions is equal to the flux at the required exact altitude. Having the void regions 1 cm thick caused the flux units to be photons/cm^2-sec in the output of the FMC code.

2.2 Input and Output Energy Groups

The input energy group bounds, which correspond to the input energy group numbers, are given in Table 2.1. The output energy group bounds, which correspond to the output energy group numbers, are given in Table 2.2.

2.3 Gamma Cross Sections

The microscopic cross sections of the elements in soil and in air were taken from Reference 2. The same cross sections were utilized in the previous study. Therefore, the macroscopic cross sections for each material region are the same as those used in Reference 1. Tables 2.3 and 2.4 give the relative compositions of the ground and the air. Table 2.5 shows the density of air as a function of altitude.

2.4 Results of Calculations

The results are listed for the seven altitudes of the study in Appendixes A and B. Appendix A is a tabulation of the flux in each output energy group, at each study altitude, for each of the nine input source groups, per 2000 source photons (the 2000 source photons represent the number of histories run for each source energy group). Appendix B is a flux tabulation in the usual form for differential spectra, on a unit source strength basis, i.e., Appendix B values equal Appendix A values divided by the product 2000 x Output Energy Width in Mev.

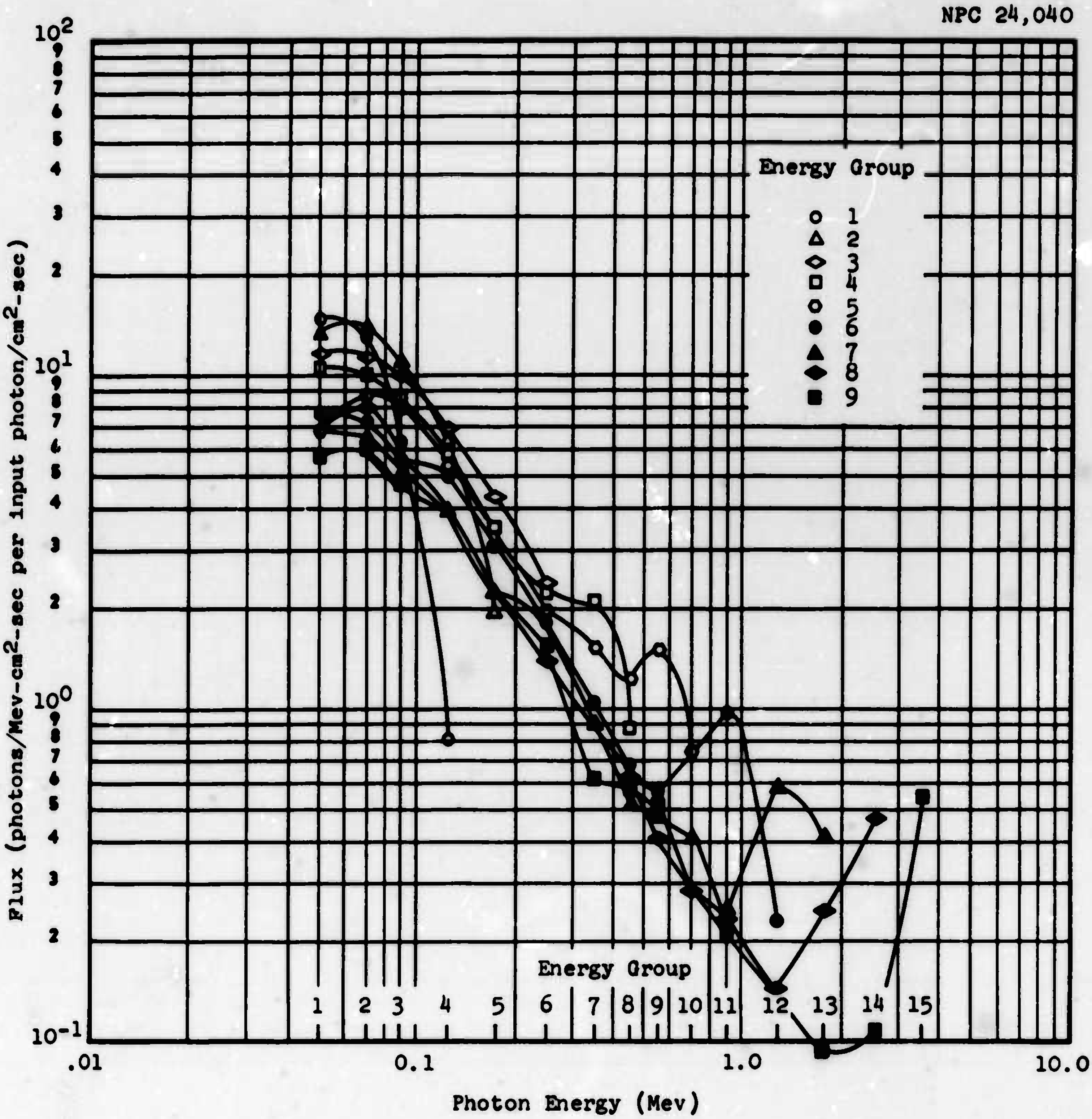


Figure 2.1 Parametric Data: Altitude, 200 Feet

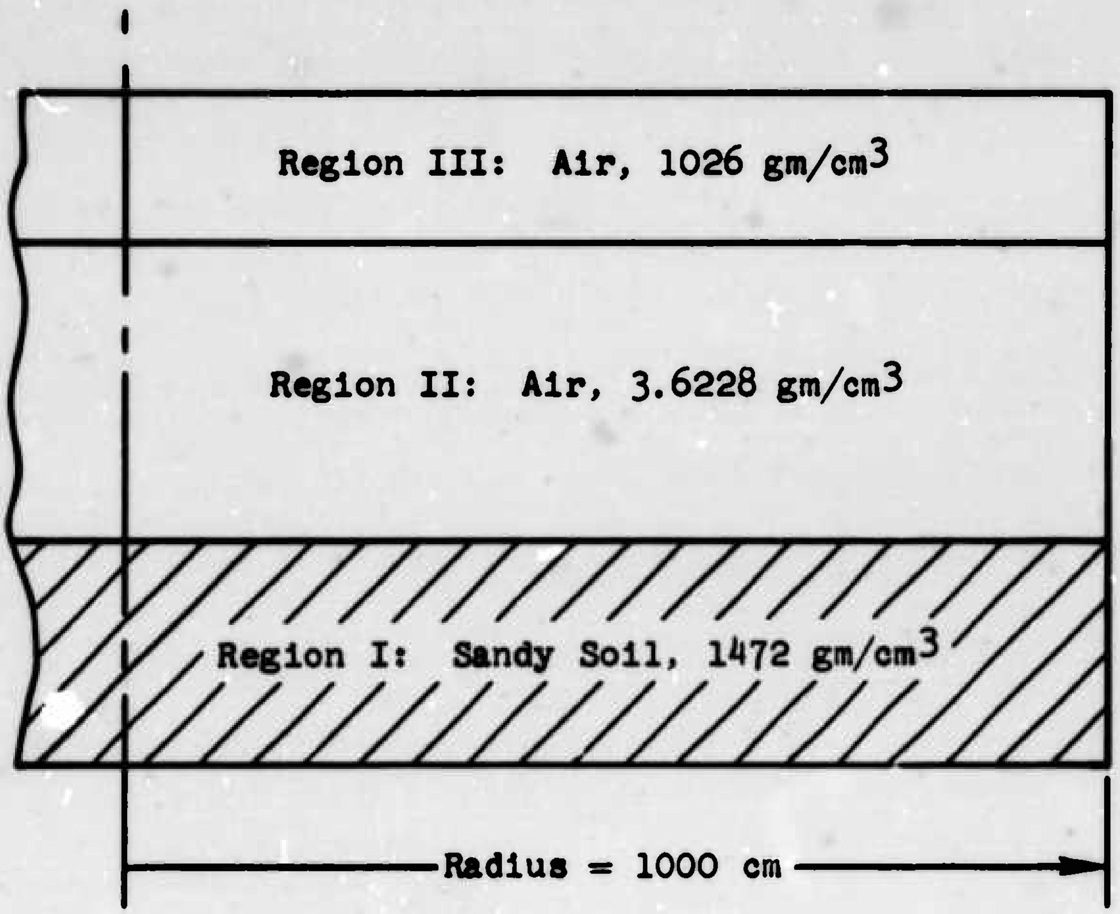


Figure 2.2 Mathematical Model Showing Material Pseudo Densities

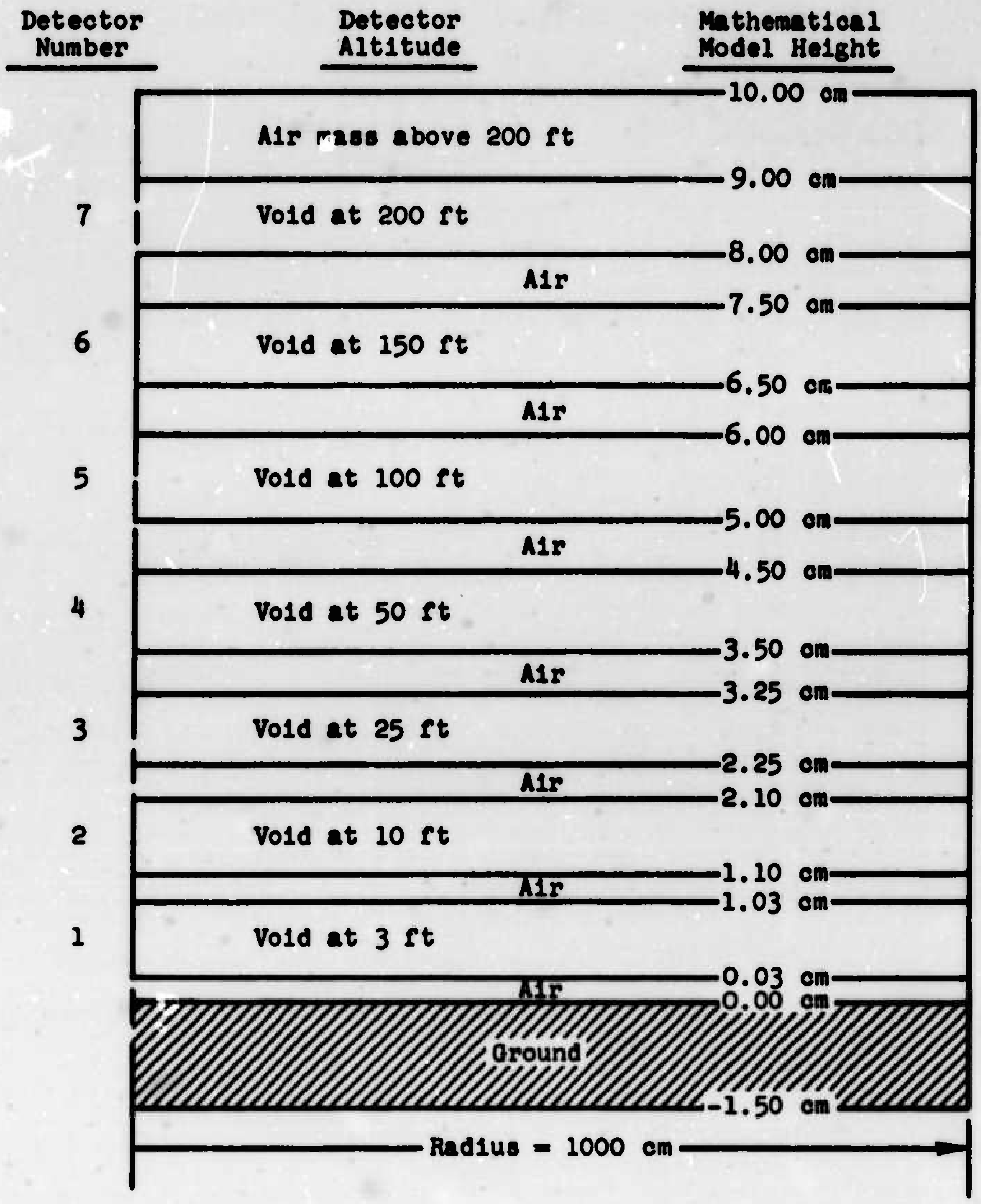


Figure 2.3 Mathematical Model Showing Geometric Regions (not to scale)

TABLE 2.1

Upper and Lower Limits of Input Energy Groups

Group No.	Lower Limit (Mev)	Upper Limit (Mev)
1	0.0643	0.1142
2	0.1142	0.1904
3	0.1904	0.2856
4	0.2856	0.4663
5	0.4663	0.7373
6	0.7373	1.1424
7	1.1424	1.8655
8	1.8655	2.9496
9	2.9496	4.0000

TABLE 2.2

Upper and Lower Limits of Output Energy Groups

Group No.	Lower Limit (Mev)	Upper Limit (Mev)
1	0.04	0.06
2	0.06	0.08
3	0.08	0.10
4	0.10	0.15
5	0.15	0.20
6	0.20	0.30
7	0.30	0.40
8	0.40	0.50
9	0.50	0.60
10	0.60	0.80
11	0.80	1.00
12	1.00	1.50
13	1.50	2.00
14	2.00	3.00
15	3.00	4.00

TABLE 2.3

Composition of Model Sandy Soil

Element	Pseudo-Density (gm/cm^3)
H	4.78
O	765.0
Si	560.0
Al	65.0
Fe	22.1
Ca	55.2

TABLE 2.4

Composition of Atmosphere by Volume*

Molecule	Percent
N_2	78.03
O_2	20.99
A	0.94
CO_2	0.03
H_2 ignored	0.01
Ne	0.0012
He	0.0004

*Adapted from Reference 3.

TABLE 2.5

Summertime Variation With Altitude of Temperature, Pressure, and Density of the Atmosphere

Elevation (km)	Temperature (^{o}C)	Pressure (mm-Hg)	Density, Dry Air (gm/cm^3)
1.5	10.0	635.4	0.001043
1.0	12.0	674.8	0.001100
0.5	14.5	716.3	0.001157
0.0	15.7	760.0	0.001223

III. CALCULATION OF FALLOUT FISSION-PRODUCT SPECTRA

The methods used to apply the fallout fission-product spectra to the parametric data in order to obtain the desired number and dose-rate spectra as functions of altitude and decay time are described in this section. The results are presented in Appendix C (differential number spectra) and Appendix D (multigroup dose-rate spectra).

The U^{235} fission-product decay spectra for the 11 decay times of this study (Table 3.1) were obtained from Reference 4. The spectral data, with volatile elements removed, were derived from the yield theory of Glendenin et al. (Ref. 5). The differential spectra given at 18 energy points in Reference 4 were converted to multigroup spectra with 9 energy groups. This was accomplished by FORTRAN code V-27 (a modified version of the U-15 code written for the previous study) in such a way that the total energy flux was conserved. The formulas given below are the same as those in the V-27 source deck except for the substitution of standard mathematical symbols:

$$\mathrm{SPEC1(I,J)} = \left[\mathrm{EAVE(2I-1)} \cdot \mathrm{SPEC(2I-1,J)} \cdot \mathrm{DEL(2I-1)} + \mathrm{EAVE(2I)} \cdot \mathrm{SPEC(2I,J)} \cdot \mathrm{DEL(2I)}\right] \div \left[\mathrm{EAVE1(I)}\right]$$

where

$$\mathrm{EAVE1(I)} = 0.5 \left[\mathrm{EAVE(2I-1)} - 0.5\ \mathrm{DEL(2I-1)} + \mathrm{EAVE(2I)} + 0.5\ \mathrm{DEL(2I)}\right]$$

and

SPEC1(I,J) = flux of the fallout fission products within the Ith energy group of the Jth spectrum (photons/sec per 10^4 fissions)

EAVE(N) = average energy in Mev of the Nth fallout fission-product energy group, EAVE(N+1)>EAVE(N)

DEL(N) = width in Mev of the Nth fallout fission-product energy group

SPEC(N,J) = number flux* of the fallout fission products at the Nth energy point of the Jth spectrum (photons/sec-Mev per 10^4 fissions)

N,I,J = integer subscripts such that

$1 \leq N \leq 18$, energy points in differential spectrum
$1 \leq I \leq 9$, input energy group
$1 \leq J \leq 11$, fallout fission-product spectrum (decay time).

The 9-energy-group input source spectra thus obtained were then applied to the results of the parametric output spectral data at each detector altitude. The V-27 procedure accomplished this according to the following formula:

$$\mathrm{FLK(M,L,J)} = \sum_{I=1}^{9} \left\{ \left[\mathrm{SPEC1(I,J) \cdot FLUK(M,L,I)}\right] \div \left[\mathrm{THCK(L) \cdot DELO(M)}\right] \right\}$$

where

FLUK(M,L,I) = flux in output energy group M and geometric region L (altitude) from parametric input energy group I per 2000 histories.

THCK(L) = 2000 times the geometrical factor (detector region thickness in centimeters in the mathematical model) of region L, to convert track length in a region to flux per source particle.

DELO(M) = width in Mev of output energy group M, used to convert multigroup spectra to differential spectra.

M,L = integer subscripts such that

$1 \leq M \leq 15$, output energy group
$1 \leq L \leq 9$, detector altitude

*Number flux is the shortened nomenclature for the differential energy spectrum of the number flux. SPEC(N,J) times DEL(N) equals flux in the Nth energy group of the Jth spectrum.

The IBM printout of these calculations is reproduced in Appendix C. The fission-product decay times that correspond to the input spectral numbers are listed in Table 3.1. The energy bounds that correspond to the energy group numbers are listed in Table 2.2.

The multigroup dose-rate tables in Appendix D were computed from the data in Appendix C. Each differential flux value was multiplied by the energy width of its group, DELO(M), and a flux-to-dose conversion factor, FTD(M). The energy-dependent flux-to-dose conversion factors were obtained from Reference 6. For the purpose of this study, the units were converted from rad/hr per photon/cm^2-sec to mr/hr per photon/cm^2-sec. This was done by multiplying the air dose factors by 10^3 mr/r and dividing by 0.93 rad/r.

TABLE 3.1

Fission-Product Decay Times

Input Spectrum Number	Time After Fission for Which the Source Spectra were Calculated
1	1.12 hours
2	2.40 hours
3	5.16 hours
4	11.1 hours
5	23.8 hours
6	2.13 days
7	4.57 days
8	9.82 days
9	21.1 days
10	45.3 days
11	97.3 days

IV. ANALYSIS OF DATA

The basic objective of this study was to extend the fallout radiation spectral data of the previous study (Ref. 1) to low altitudes. Accordingly, spectral data were developed for the exact altitudes of 3, 10, 25, 50, 100, and 200 ft for the 11 decay times of the previous study.

To help detect relatively small changes in spectral shapes with altitude and decay time, the analysis section of the V-27 code was modified and used to perform relative-change calculations. The results are tabulated in Appendixes E, F, G, and H. These tables illustrate trends and were used as criteria for the selection of sample graphs of the spectral data.

4.1 Analysis Calculations

Four sets of comparisons were calculated. In each set, the elementary calculation consisted of comparing Spectrum "I" with Spectrum "J." This was done by normalizing Spectrum I to to the first energy group of Spectrum J, then subtracting the value of 1.0 from the flux ratio in each energy group (the flux in the Nth energy group of I divided by the flux in the Nth energy group of J). The results are the relative decimal changes in each of the higher-energy groups. One hundred times the fractional change (positive if an increase, negative if a decrease) is the approximate percent relative change in energy group N of Spectrum I with respect to energy group N of Spectrum J.

The first set of comparison data is given in Appendix E. For each of the seven altitudes of this study, the spectra for all decay times are compared to the spectrum for the first decay time (1.12 hr after fission).

The second set of comparison data is given in Appendix F. For each altitude of the study, the spectrum at each decay time is compared to the spectrum at the previous decay time.

The third set of comparison data is given in Appendix G. For each of the 11 decay times of this study, the spectra at all altitudes are compared to the spectrum at the first altitude (3 ft).

The fourth set of comparison data is given in Appendix H. For each decay time of the study, the spectrum at each altitude is compared to the spectrum at the previous altitude.

4.2 Representative Graphs

Figures 4.1 through 4.8 were selected to show the maximum variations in the calculated spectra with altitude and decay time.

Data on total dose rates were obtained from Appendix D by summing the multigroup dose rates over energy for all altitudes and decay times of this study. The results are shown in Table 4.1 Dose-rate reduction factors vs altitude were obtained for each decay time. This was done by normalizing the total-dose-rate-vs-altitude data to unit dose rates at 3 ft. The results are shown in Table 4.2. The dose-rate reduction factor is plotted in Figure 4.9. The single curve on Figure 4.9 represents all decay times from 1.12 hr to 97.3 days. Similar total dose rate and dose-rate reduction-factor data for higher altitudes are shown in Tables 4.3 and 4.4 and in Figure 4.10. These data, with the exception of the data at 3 ft, were obtained from Appendix D of Reference 1.

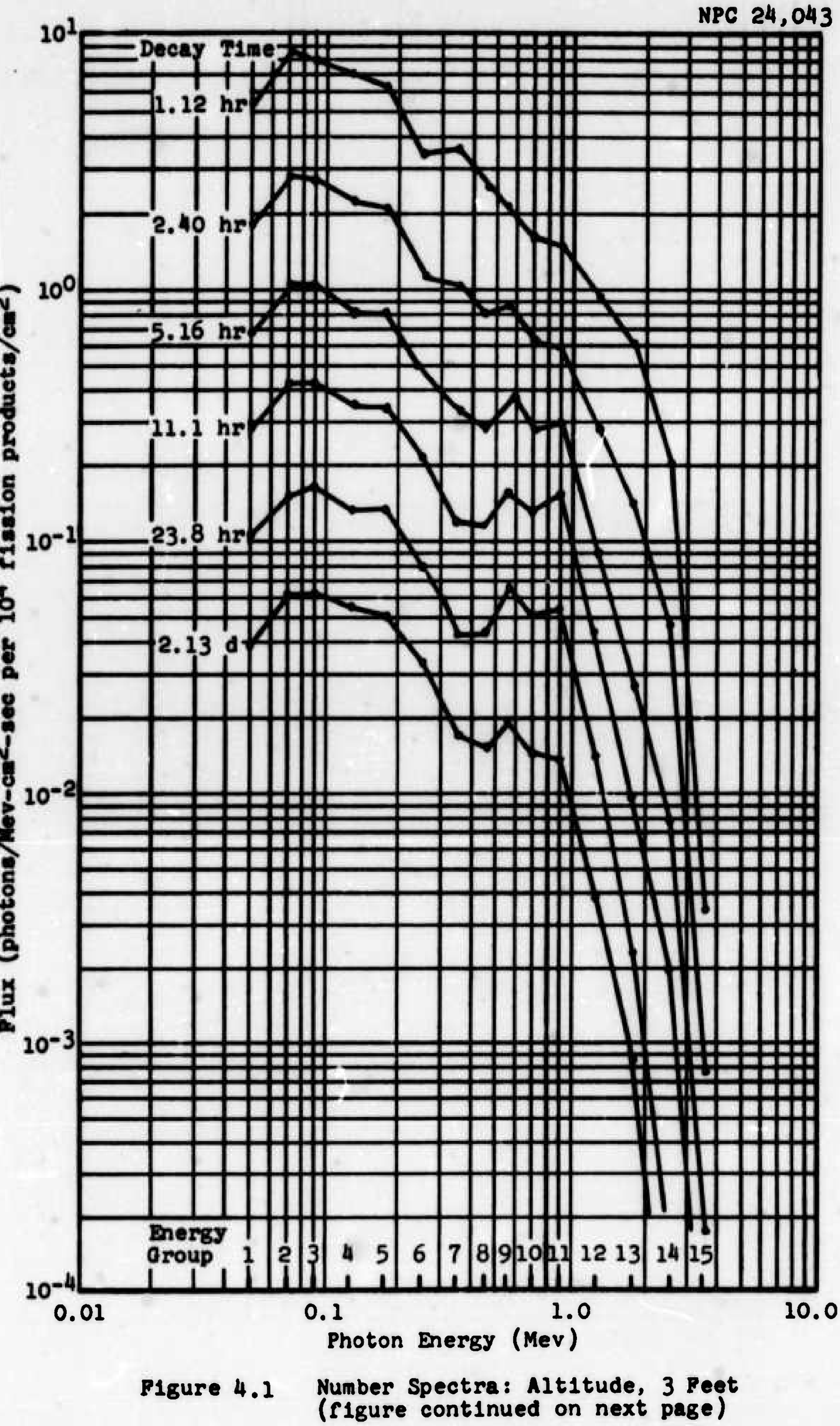


Figure 4.1 Number Spectra: Altitude, 3 Feet
(figure continued on next page)

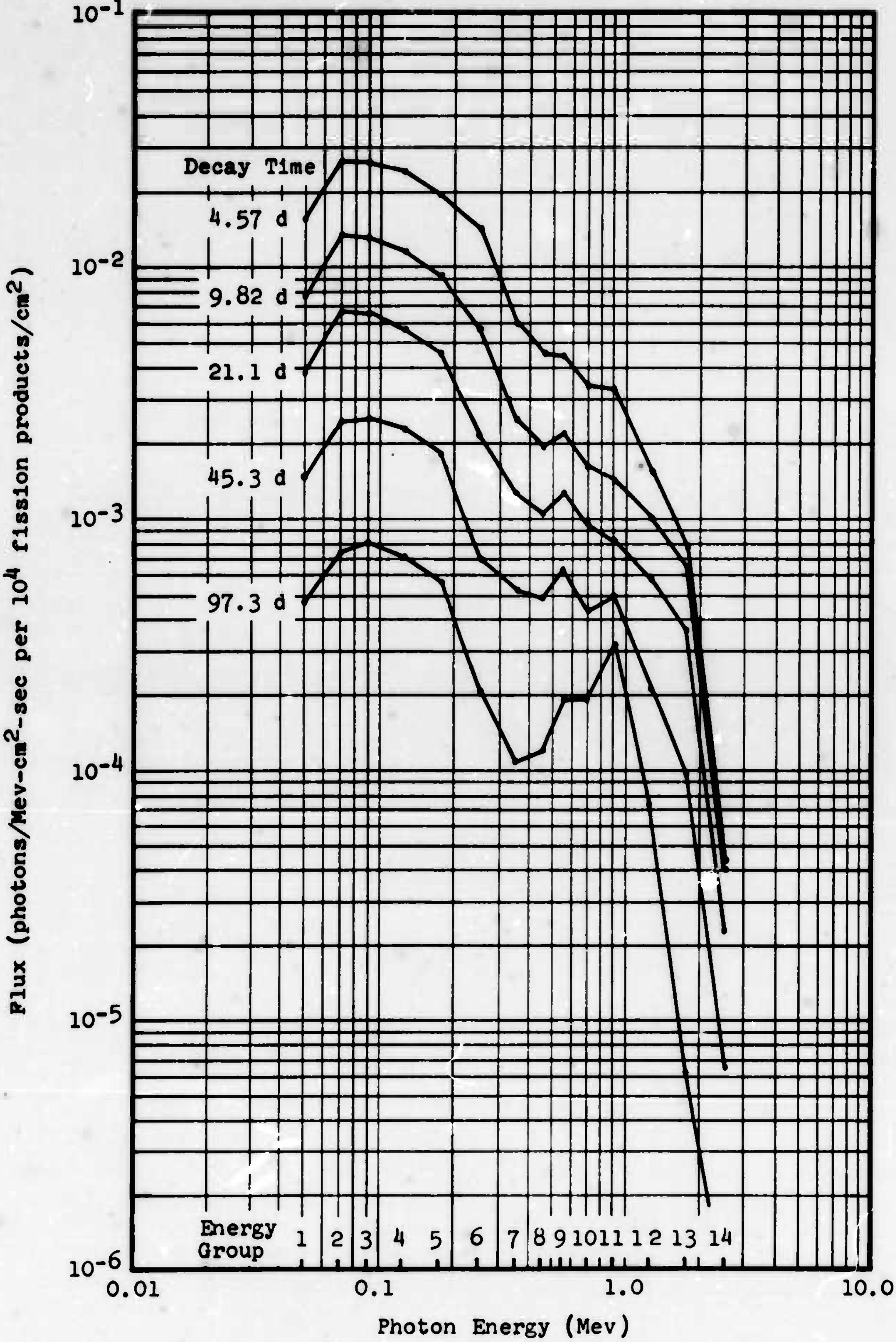


Figure 4.1 (cont'd) Number Spectra: Altitude, 3 Feet

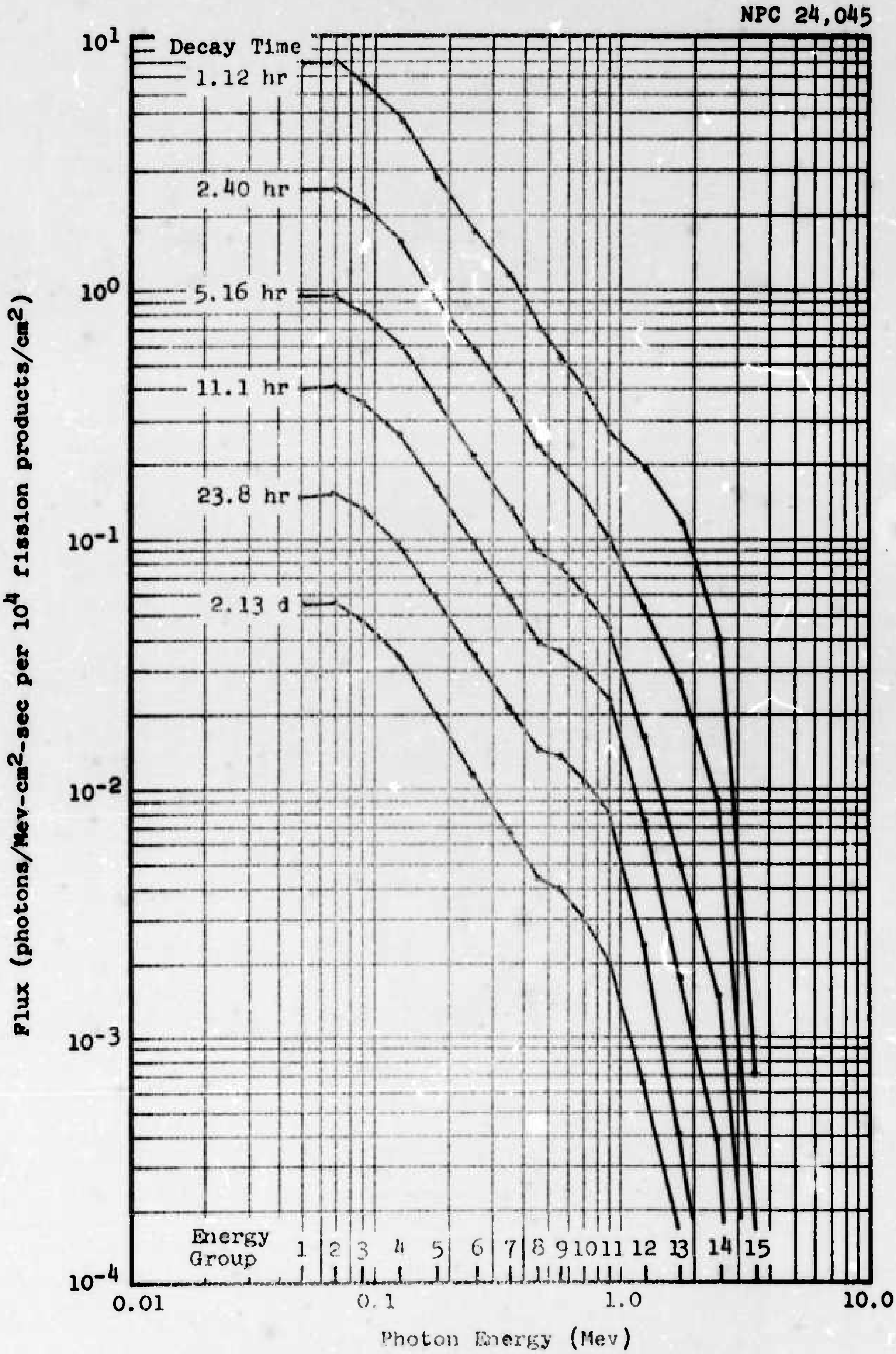


Figure 4.2 Number Spectra: Altitude, 200 Feet
(figure continued on next page)

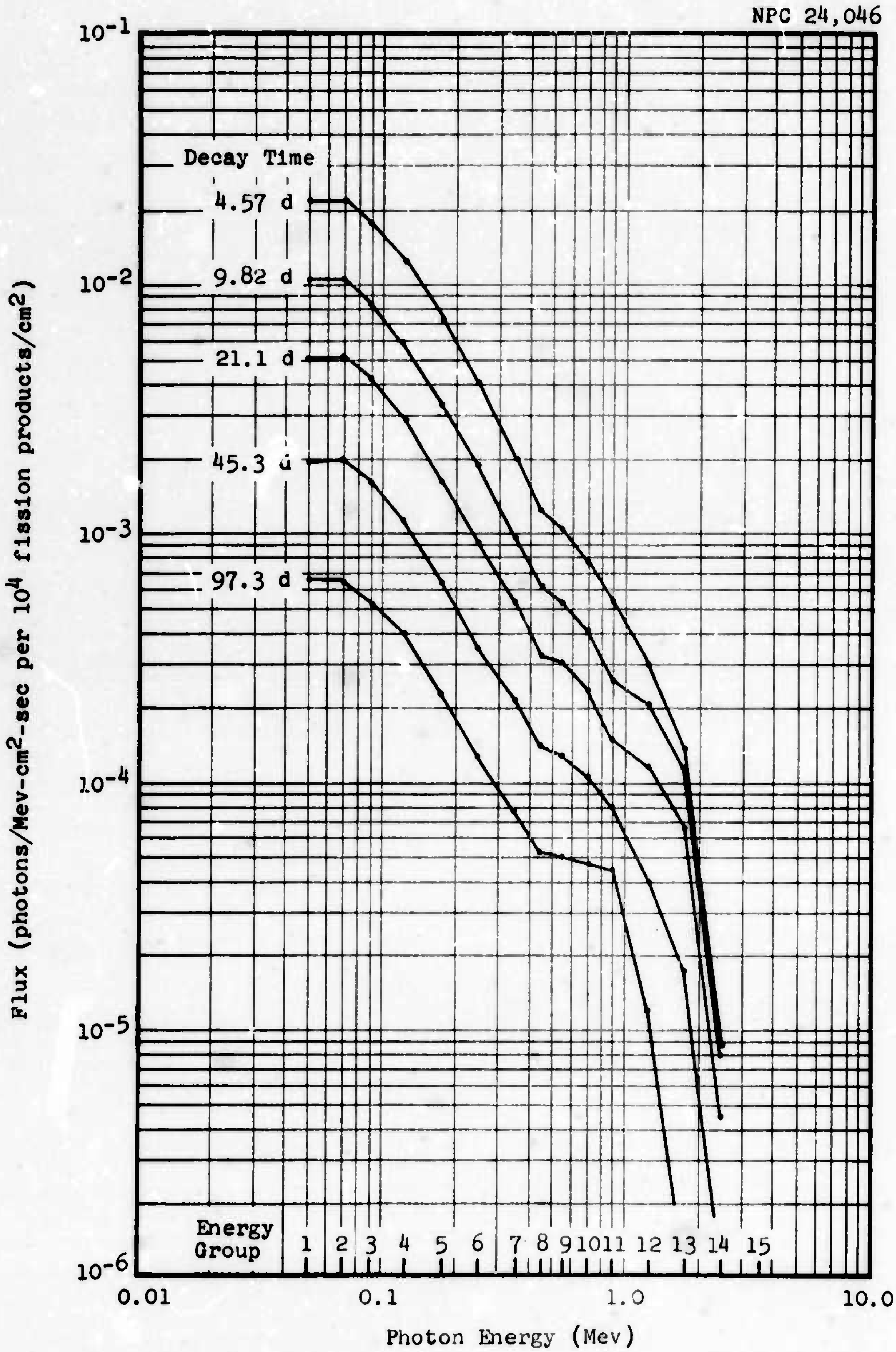


Figure 4.2 (cont'd) Number Spectra: Altitude, 200 **Feet**

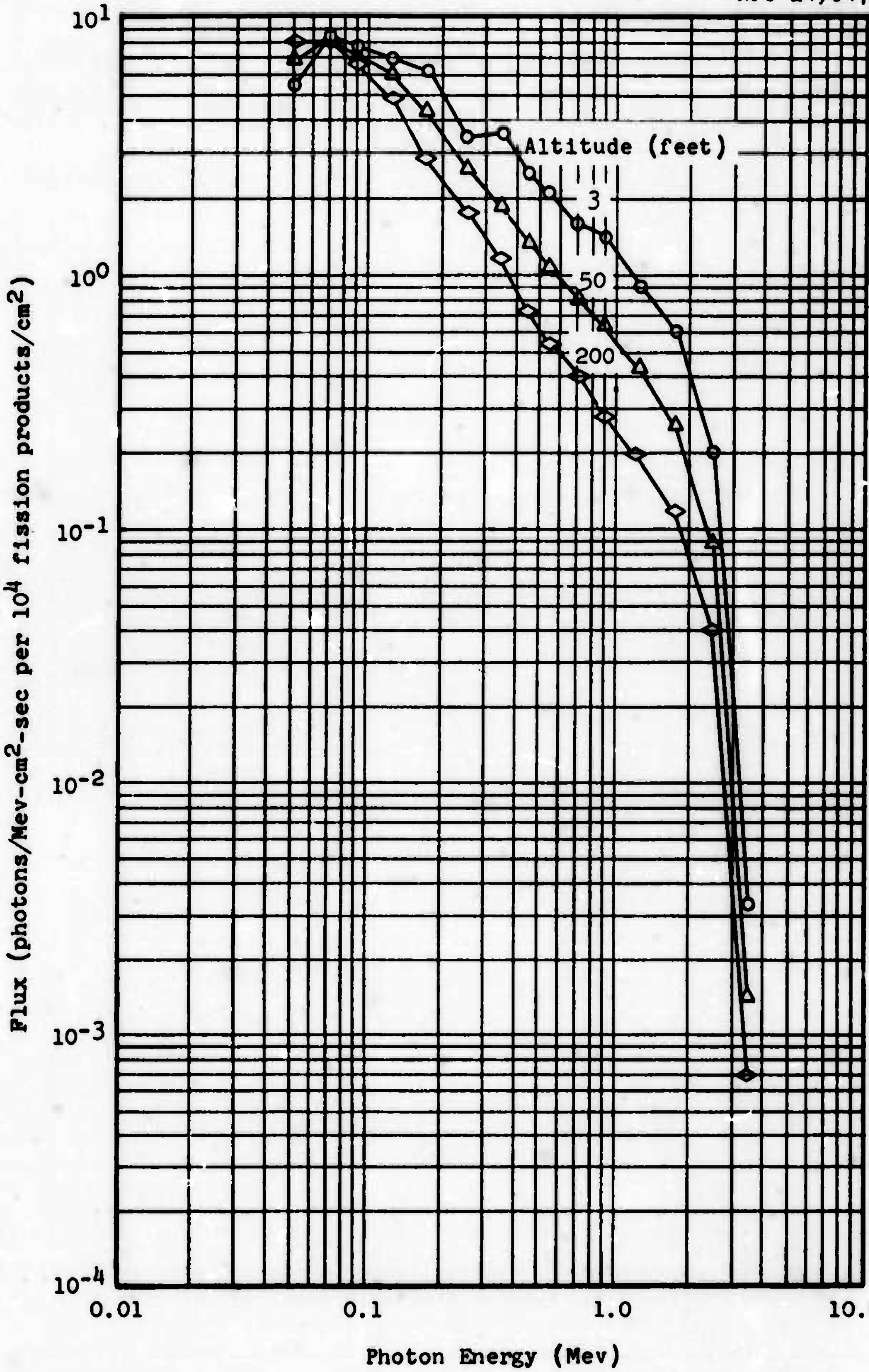


Figure 4.3 Number Spectra: Decay Time, 1.12 Hours

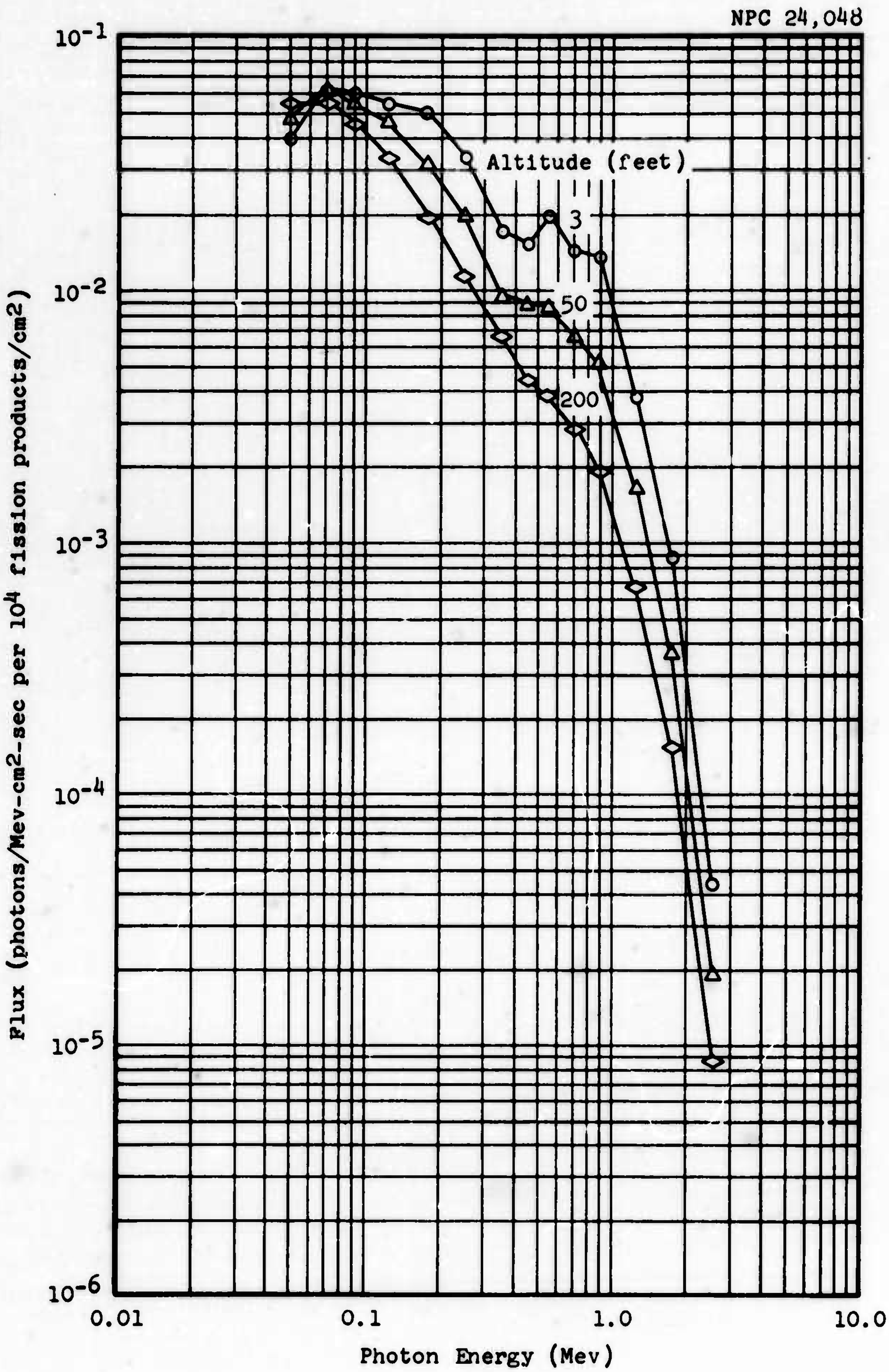


Figure 4.4 Number Spectra: Decay Time, 2.13 Days

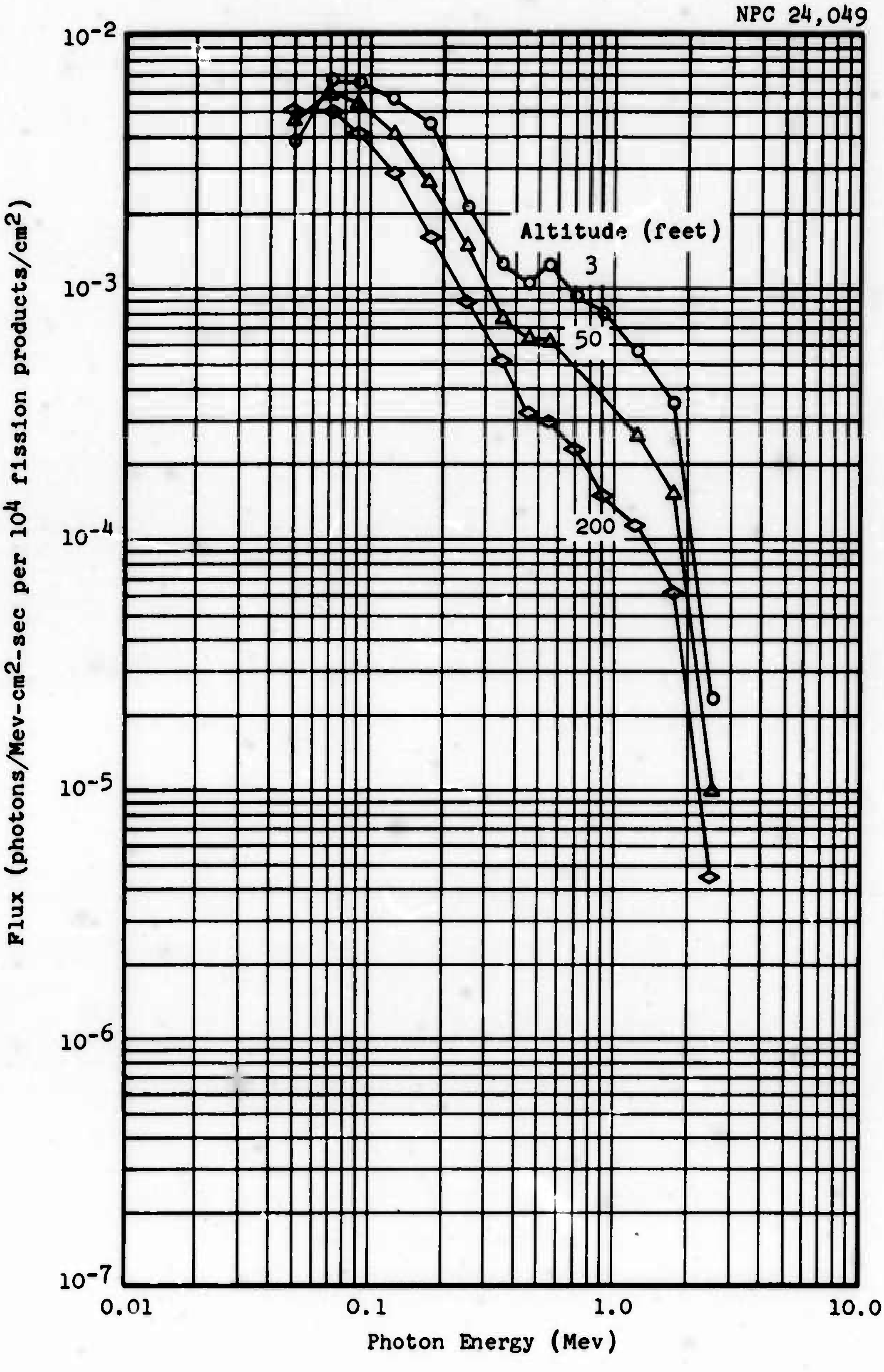


Figure 4.5 Number Spectra: Decay Time, 21.1 Days

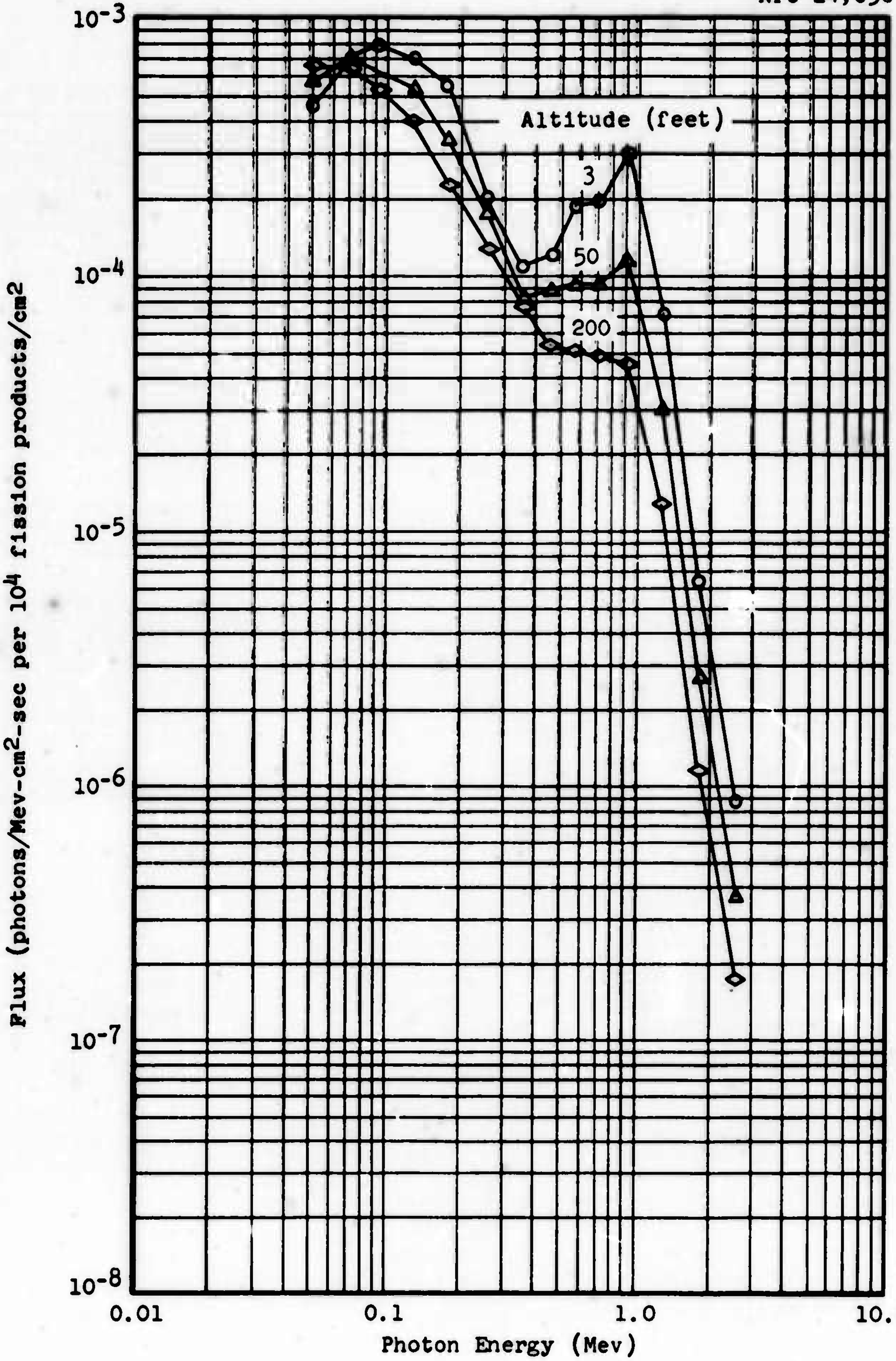


Figure 4.6 Number Spectra: Decay Time, 97.3 Days

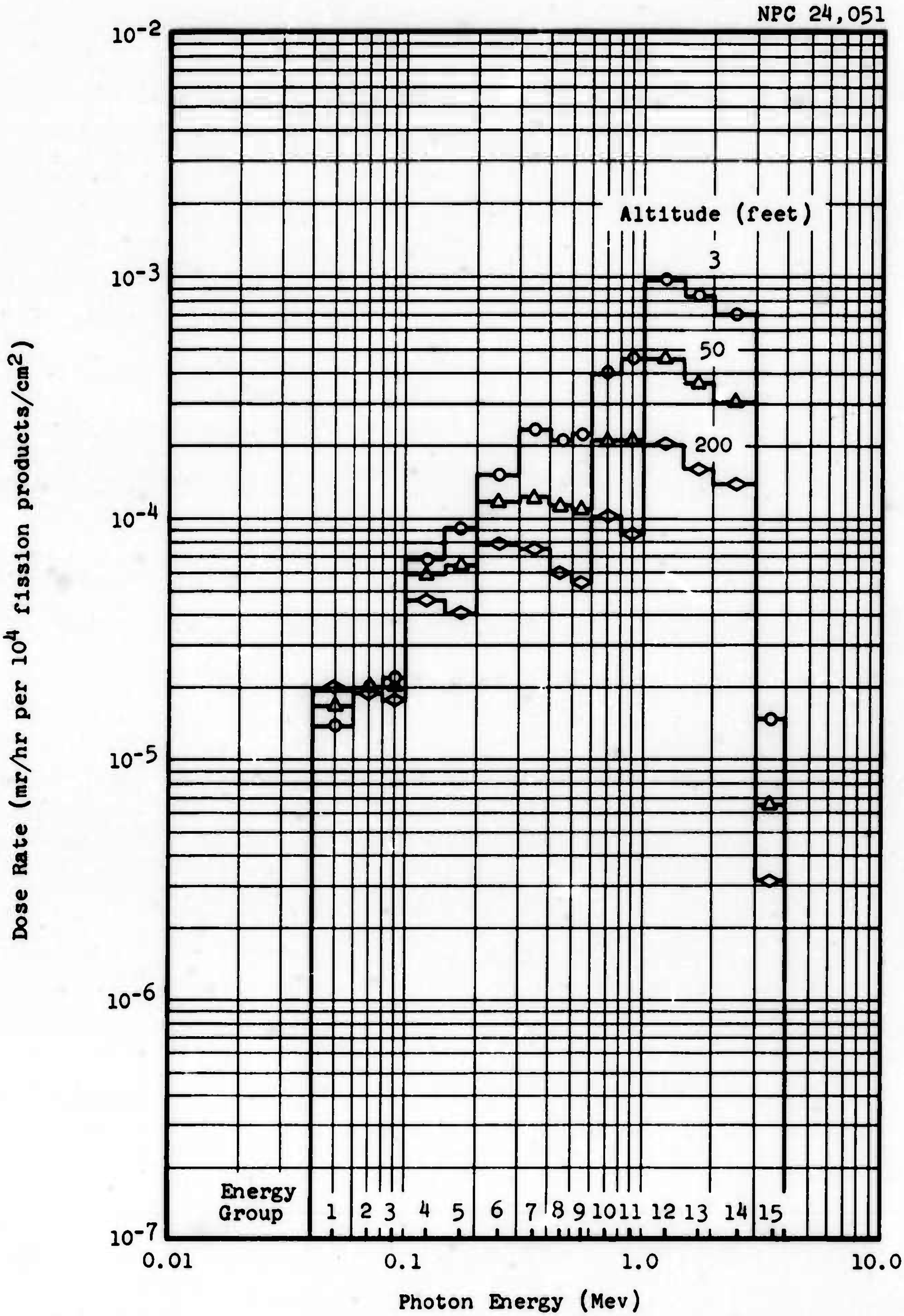


Figure 4.7 Multigroup Dose-Rate Spectra: Time, 1.12 Hours

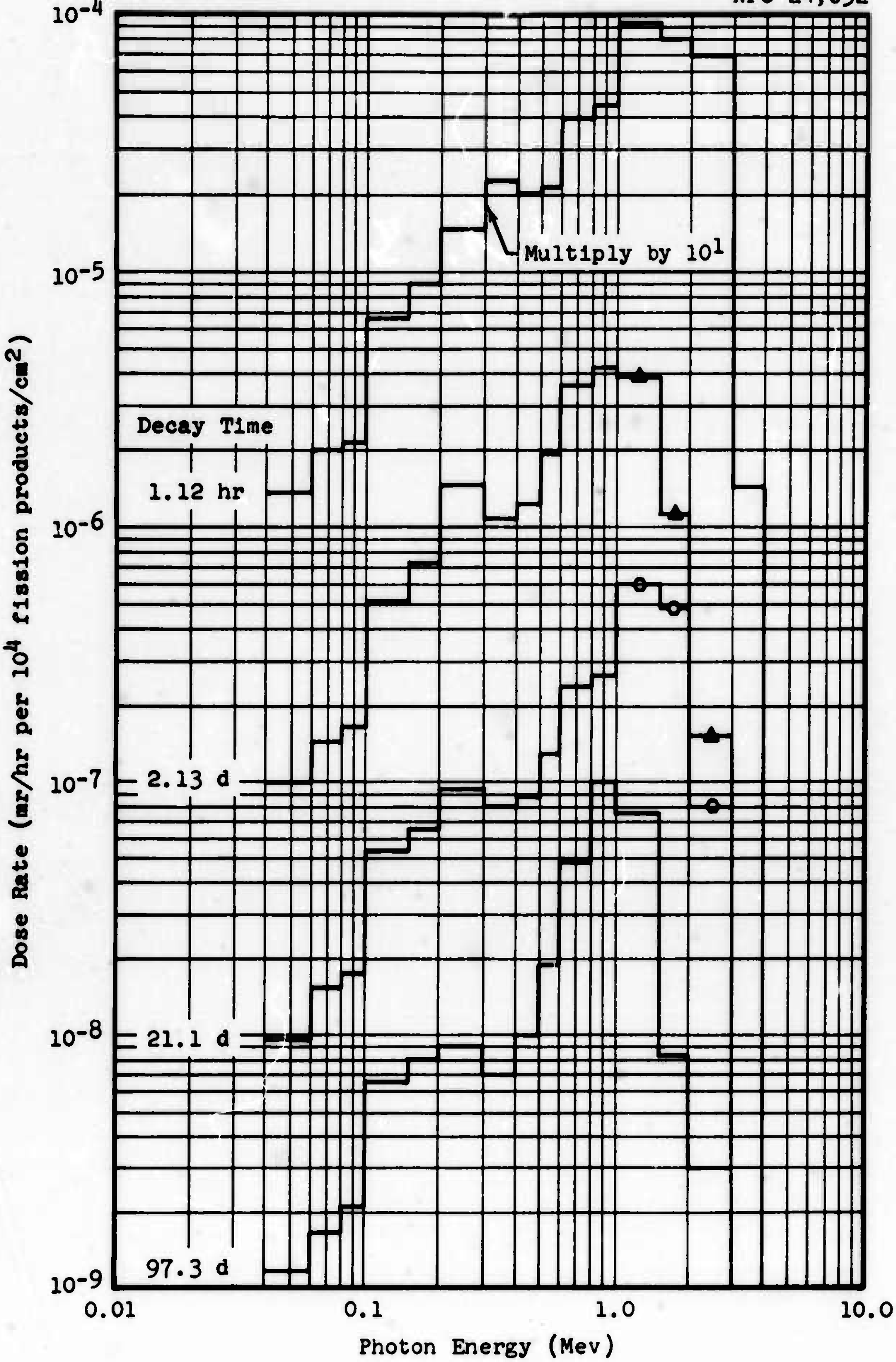


Figure 4.8 Multigroup Dose-Rate Spectra: Altitude, 3 Feet

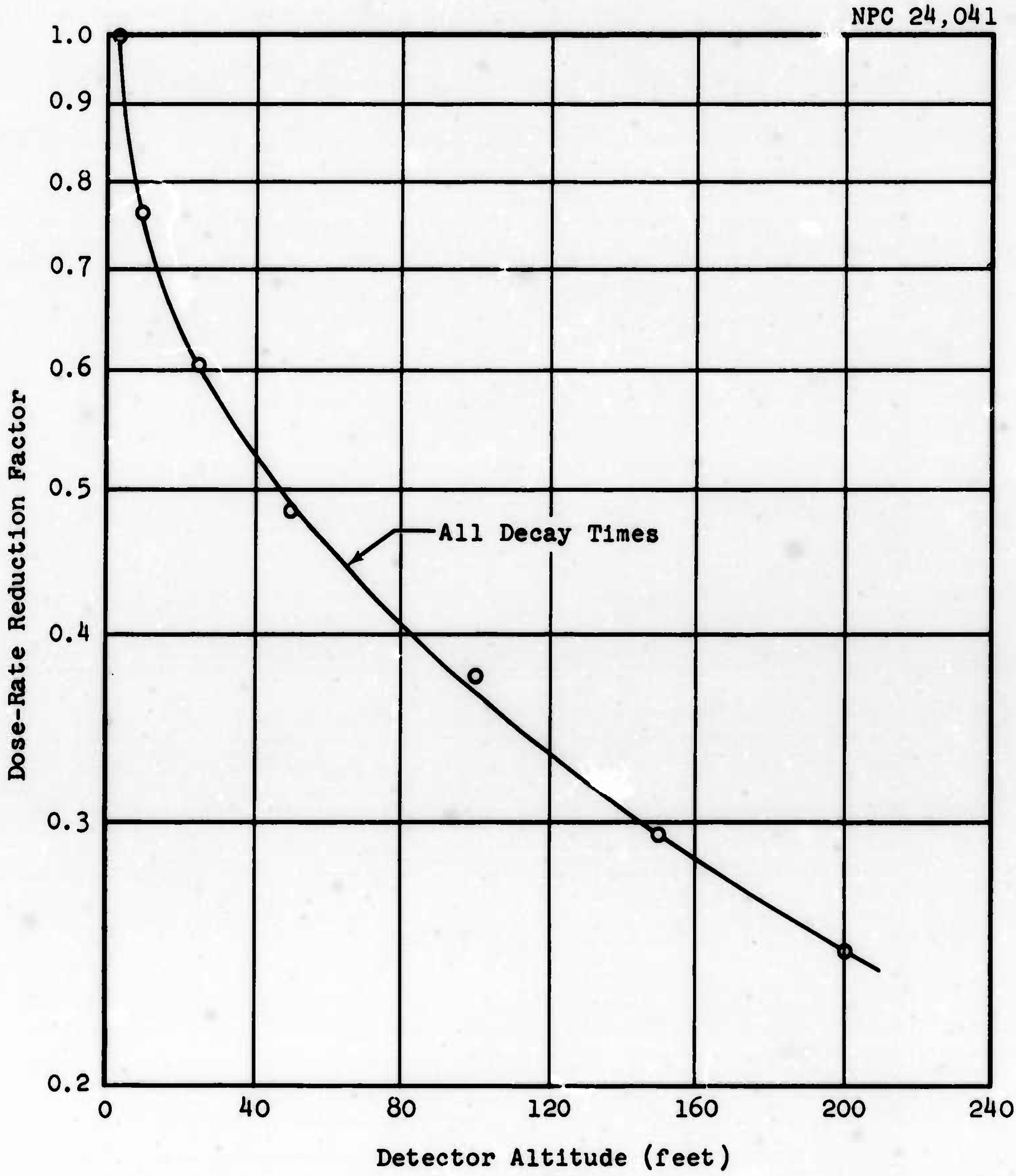


Figure 4.9 Dose-Rate Reduction with Altitude: 3 to 200 Feet

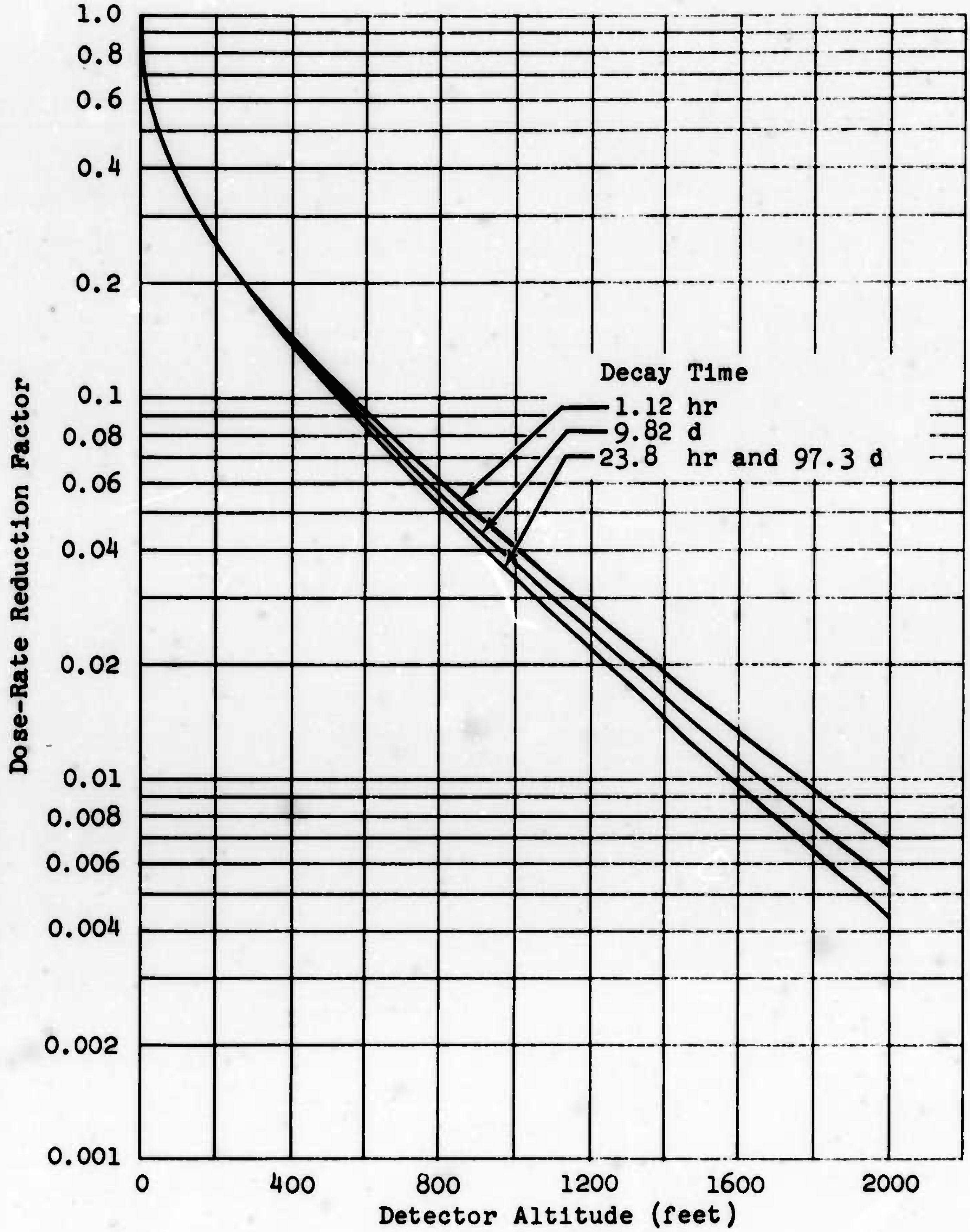


Figure 4.10 Dose-Rate Reduction with Altitude: 3 to 2000 Feet

TABLE 4.1

Total Gamma Dose Rate vs Altitude and Decay Time; 3 to 200 Feet
(mr/hr for 10^4 fission products/cm^2)

Decay Time	Altitude						
	3 ft	10 ft	25 ft	50 ft	100 ft	150 ft	200 ft
1.12 hr	4.307-03*	3.286-03	2.614-03	2.137-04	1.616-03	1.293-03	1.076-03
2.40 hr	1.301-03	9.920-04	7.876-04	6.388-04	4.882-04	3.881-04	3.231-04
5.16 hr	4.380-04	3.339-04	2.642-04	2.117-04	1.644-04	1.291-04	1.077-04
11.1 hr	1.958-04	1.492-04	1.179-04	9.412-05	7.350-05	5.743-05	4.794-05
23.8 hr	6.691-05	5.089-05	4.025-05	3.205-05	2.512-05	1.961-05	1.635-05
2.13 d	2.009-05	1.535-05	1.213-05	9.701-06	7.549-06	5.921-06	4.930-06
4.57 d	7.101-06	5.451-06	4.316-06	3.513-06	2.665-06	2.122-06	1.761-06
9.82 d	3.983-06	3.049-06	3.421-06	1.994-06	1.494-06	1.202-06	9.938-07
21.1 d	2.173-06	1.658-06	1.318-06	1.085-06	8.140-07	6.553-07	5.415-07
45.3 d	8.375-07	6.383-07	5.060-07	4.110-07	3.140-07	2.494-07	2.068-07
97.3 d	2.958-07	2.249-07	1.773-07	1.403-07	1.111-07	8.566-08	7.165-08

*Read 4.307-03 as 4.307×10^{-3}

TABLE 4.2

Gamma Dose-Rate Reduction Factor vs Altitude and Decay Time: 3 to 200 Feet
(normalized to the dose rate at 3 ft)

Decay Time	Altitude						
	3 ft	10 ft	25 ft	50 ft	100 ft	150 ft	200 ft
1.12 hr	1.000	0.763	0.607	0.496	0.375	0.300	0.250
2.40 hr	1.000	0.762	0.605	0.491	0.375	0.298	0.248
5.16 hr	1.000	0.762	0.603	0.483	0.375	0.295	0.246
11.1 hr	1.000	0.762	0.602	0.481	0.375	0.293	0.245
23.8 hr	1.000	0.762	0.602	0.479	0.375	0.293	0.244
2.13 d	1.000	0.764	0.604	0.483	0.376	0.295	0.245
4.57 d	1.000	0.768	0.608	0.495	0.375	0.299	0.248
9.82 d	1.000	0.766	0.608	0.501	0.375	0.302	0.250
21.1 d	1.000	0.763	0.607	0.499	0.375	0.302	0.249
45.3 d	1.000	0.762	0.604	0.491	0.375	0.298	0.247
97.3 d	1.000	0.760	0.599	0.474	0.376	0.290	0.242

TABLE 4.3

Total Gamma Dose Rate vs Altitude and Decay Time: 3 to 2000 Feet
(mr/hr for 10^4 fission products/cm^2)

Decay Time	Altitude					
	3 ft	200 ft	500 ft	1000 ft	1500 ft	2000 ft
1.12 hr	4.307-03*	1.116-03	4.973-04	1.707-04	6.989-05	2.522-05
23.8 hr	6.691-05	1.693-05	7.106-06	2.239-06	8.099-07	2.508-07
9.82 d	3.983-06	1.035-06	4.443-07	1.448-07	5.565-08	1.932-08
97.3 d	2.958-07	7.469-08	3.180-08	1.002-08	3.677-09	1.150-09

*Read 4.307-03 as 4.307 x 10^{-3}

TABLE 4.4

Gamma Dose-Rate Reduction Factor vs Altitude and Decay Time: 3 to 2000 Feet
(normalized to the dose rate at 3 ft)

Decay Time	Altitude					
	3 ft	200 ft	500 ft	1000 ft	1500 ft	2000 ft
1.12 hr	1.0000	0.2591	0.1155	0.0396	0.0162	0.0058
23.8 hr	1.0000	0.2530	0.1062	0.0335	0.0121	0.0037
9.82 d	1.0000	0.2600	0.1115	0.0364	0.0140	0.0049
97.3 d	1.0000	0.2525	0.1075	0.0339	0.0124	0.0039

V. CONCLUSIONS

It is concluded that (1) the fission-product spectrum at 1.12 hr after fission and at a detector altitude of 3 ft is the hardest of all the spectra; (2) the spectrum softens with decay time through 2.13 days, becomes harder through 21.1 days, then resumes softening through 97.3 days; and (3) the spectrum undergoes a constant and rapid softening with increasing detector altitude from 3 to 200 ft. It continues to soften up to about 800 ft. These variations show up better on the figures of multigroup dose rates (Figs. 4.7 and 4.8) than on the differential number spectra.

Results of comparisons with low-altitude spectral data of Reference 1 were about as expected. The methods of the previous study introduced some error into the calculated flux below 200 ft. At a detector altitude of 25 ft, the results of the previous study are approximately 15% high. At 200 ft, this is reduced to about 4%.

For the idealized smooth-ground geometry of this study, total dose rates decrease rapidly with height above 3 ft. The dose rates at 200 ft are about 25% of the dose rates at 3 ft. Figure 4.10 shows that the decrease in total dose rate with altitude is nearly independent of decay time for altitudes below 400 ft.

VI. RECOMMENDATIONS FOR RELATED STUDIES

The relatively sharp decrease in dose rate with the first 25-ft increase in altitude (Fig. 4.9) can be used as a measure of the importance of ground-roughness effects. The mass thickness of 25 ft of air can be thought of as approximating (with respect to fallout-gamma-dose attenuation) a very thin layer of soil or mixture of fallout and soil. The effect of ground roughness would therefore modify the dose-vs-altitude relationships that have been developed for an idealized plane. It is also recognized that ground roughness significantly changes the relative importance (contribution to the total dose rate at any given altitude) of the fallout activity located within any given area on the ground. Therefore, present data (Ref. 7) of dose-reduction factor vs altitude and radius of cleared area, which are based on an idealized smooth plane in an infinite-water medium, are not very realistic. In a practical situation, considerable error in estimating cleanup requirements could result from the use of these simplified-geometry data.

It is recommended that the importance of ground roughness on dose reduction vs altitude and radius of cleared area be studied quantitatively in a realistic geometry. Some of the techniques used in the present study could be applied. Judicious selection of ground-roughness-simulated geometries corresponding to possible real conditions would allow development of realistic parametric data. Correlations of ground roughness and dose reduction with altitude should allow development of a simple procedure to determine experimentally the effective ground roughness of any contaminated area of interest. Once the effective ground roughness is established for an area, the proper ground-roughness-dependent curve of dose-reduction factor vs radius of cleared area could be used for a more realistic assessment of clearing requirements.

Ground-roughness effects would also influence the placement of, and the detector geometry for, automatic monitoring systems. The recommended study would evaluate, as a function of radius of contaminated area below a detector, the combined effects of the following parameters:

a. Ground roughness

b. Detector height above the ground

c. Fission-product decay time

Since ground-roughness effects would tend to "shrink" the ground area making an important contribution to the total detector response, the results of the study would probably suggest that any or all of the following modifications be made to monitoring systems based on infinite-smooth-plane calculations:

1. Closer lateral placement than for idealized smooth plane calculations.

2. Higher placement aboveground (to minimize ground-roughness effects).

3. Increased desirability of the use of skyshine meters (to minimize ground-roughness effects).

APPENDIX A

PARAMETRIC DATA IN MULTIGROUP FORM
(Computer Printout)

TABLE A-1

FLUX IN OUTPUT ENERGY GROUP SHOWN PER 2000 SOURCE
PHOTONS / SQ CM-SEC FROM INPUT ENERGY GROUP 1

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	8.663+02	8.845+02	9.132+02	9.668+02	8.006+02	6.810+02	5.847+02
2	2.279+03	1.842+03	1.610+03	1.230+03	8.780+02	6.209+02	5.196+02
3	2.109+03	1.573+03	1.173+03	8.172+02	5.140+02	3.236+02	2.515+02
4	9.431+02	7.488+02	4.654+02	3.655+02	1.782+02	1.077+02	8.183+01
5	0.	0.	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	0.	0.	0.
7	0.	0.	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.
13	0.	0.	0.	0.	0.	0.	0.
14	0.	0.	0.	0.	0.	0.	0.
15	0.	0.	0.	0.	0.	0.	0.

TABLE A-2

FLUX IN OUTPUT ENERGY GROUP SHOWN PER 2000 SOURCE PHOTONS / SQ CM-SEC FROM INPUT ENERGY GROUP 2

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	4.070+02	4.348+02	4.225+02	4.966+02	5.736+02	5.695+02	5.305+02
2	6.645+02	6.832+02	6.433+02	6.675+02	7.179+02	6.605+02	5.576+02
3	8.685+02	7.726+02	7.775+02	6.553+02	6.216+02	5.341+02	4.419+02
4	3.418+03	2.431+03	2.002+03	1.619+03	1.156+03	9.383+02	6.483+02
5	2.135+03	1.568+03	1.059+03	7.585+02	4.533+02	2.866+02	1.953+02
6	0.	0.	0.	0.	0.	0.	0.
7	0.	0.	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.
13	0.	0.	0.	0.	0.	0.	0.
14	0.	0.	0.	0.	0.	0.	0.
15	0.	0.	0.	0.	0.	0.	0.

TABLE A-3

FLUX IN OUTPUT ENERGY GROUP SHOWN PER 2000 SOURCE PHOTONS / SQ CM-SEC FROM INPUT ENERGY GROUP 3

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	2.922+02	3.536+02	3.689+02	4.139+02	4.224+02	4.404+02	4.541+02
2	5.204+02	5.564+02	5.740+02	5.219+02	5.251+02	5.461+02	4.520+02
3	4.440+02	4.604+02	5.137+02	4.958+02	4.984+02	3.850+02	3.920+02
4	1.289+03	1.196+03	1.263+03	1.172+03	9.043+02	8.205+02	6.904+02
5	1.013+03	8.937+02	8.145+02	7.416+02	6.331+02	4.720+02	4.313+02
6	3.956+03	3.123+03	2.036+03	1.502+03	9.682+02	6.415+02	4.830+02
7	0.	0.	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.
13	0.	0.	0.	0.	0.	0.	0.
14	0.	0.	0.	0.	0.	0.	0.
15	0.	0.	0.	0.	0.	0.	0.

TABLE A-4

FLUX IN OUTPUT ENERGY GROUP SHOWN PER 2000 SOURCE
PHOTONS / SQ CM-SEC FROM INPUT ENERGY GROUP 4

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	2.508+02	2.605+02	2.508+02	3.150+02	3.641+02	3.991+02	4.245+02
2	4.328+02	4.075+02	4.553+02	4.559+02	4.037+02	4.028+02	4.021+02
3	3.101+02	3.669+02	3.417+02	3.202+02	4.132+02	3.578+02	3.200+02
4	8.341+02	7.754+02	8.053+02	8.352+02	6.741+02	6.070+02	5.907+02
5	6.938+02	6.638+02	6.957+02	6.364+02	4.978+02	4.349+02	3.571+02
6	1.042+03	1.041+03	8.965+02	7.662+02	6.503+02	4.960+02	4.503+02
7	2.838+03	2.025+03	1.515+03	1.108+03	7.530+02	5.447+02	4.197+02
8	1.455+03	1.016+03	7.463+02	5.337+02	3.330+02	2.369+02	1.766+02
9	0.	0.	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.
13	0.	0.	0.	0.	0.	0.	0.
14	0.	0.	0.	0.	0.	0.	0.
15	0.	0.	0.	0.	0.	0.	-0.

TABLE A-5

FLUX IN OUTPUT ENERGY GROUP SHOWN PER 2000 SOURCE
PHOTONS / SQ CM-SEC FROM INPUT ENERGY GROUP 5

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	2.409+02	2.605+02	2.756+02	2.771+02	3.460+02	3.184+02	2.781+02
2	3.341+02	3.214+02	3.654+02	3.500+02	3.965+02	3.954+02	3.425+02
3	3.709+02	3.146+02	4.350+02	3.341+02	3.551+02	3.044+02	3.430+02
4	5.688+02	5.757+02	6.483+02	5.702+02	6.544+02	6.776+02	5.383+02
5	1.032+03	5.635+02	5.338+02	5.052+02	4.302+02	4.888+02	3.534+02
6	6.677+02	6.318+02	6.079+02	6.240+02	4.940+02	4.705+02	3.944+02
7	3.408+02	3.177+02	3.832+02	2.999+02	3.527+02	2.796+02	3.103+02
8	7.889+02	6.370+02	5.583+02	4.870+02	3.403+02	3.049+02	2.458+02
9	1.947+03	1.420+03	9.829+02	7.484+02	5.702+02	3.887+02	3.026+02
10	2.128+03	1.540+03	1.122+03	8.235+02	5.551+02	4.026+02	2.995+02
11	0.	0.	0.	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.
13	0.	0.	0.	0.	0.	0.	0.
14	0.	0.	0.	0.	0.	0.	0.
15	0.	0.	0.	0.	0.	0.	0.

TABLE A-6

FLUX IN OUTPUT ENERGY GROUP SHOWN PER 2000 SOURCE
PHOTONS / SQ CM-SEC FROM INPUT ENERGY GROUP 6

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	1.893+02	2.256+02	2.026+02	2.414+02	2.551+02	2.878+02	3.078+02
2	2.609+02	2.835+02	3.868+02	2.914+02	3.013+02	3.487+02	2.893+02
3	2.853+02	2.772+02	2.919+02	2.477+02	2.651+02	2.414+02	2.243+02
4	5.283+02	5.140+02	6.084+02	5.791+02	5.944+02	5.191+02	5.130+02
5	3.798+02	3.698+02	4.110+02	3.703+02	3.811+02	3.033+02	3.131+02
6	5.400+02	5.724+02	5.972+02	4.810+02	4.367+02	4.030+02	3.682+02
7	2.945+02	3.156+02	2.321+02	2.269+02	2.579+02	2.851+02	2.143+02
8	2.285+02	2.075+02	2.797+02	2.094+02	2.340+02	1.555+02	1.358+02
9	1.492+02	1.851+02	1.507+02	1.454+02	1.498+02	1.108+02	1.120+02
10	9.369+02	7.497+02	6.409+02	5.206+02	4.311+02	3.244+02	3.050+02
11	2.732+03	1.867+03	1.344+03	1.009+03	6.773+02	4.944+02	3.884+02
12	1.441+03	1.081+03	7.955+02	5.946+02	4.579+02	3.034+02	2.317+02
13	0.	0.	0.	0.	0.	0.	0.
14	0.	0.	0.	0.	0.	0.	0.
15	0.	0.	0.	0.	0.	0.	0.

TABLE A-7

FLUX IN OUTPUT ENERGY GROUP SHOWN PER 2000 SOURCE
PHOTONS / SQ CM-SEC FROM INPUT ENERGY GROUP 7

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	1.761+02	1.862+02	1.947+02	2.251+02	2.010+02	2.021+02	2.773+02
2	3.229+02	2.862+02	3.073+02	2.868+02	3.097+02	2.636+02	2.636+02
3	2.425+02	2.290+02	3.086+02	2.961+02	2.325+02	2.156+02	2.042+02
4	4.515+02	4.992+02	4.889+02	4.413+02	4.415+02	4.613+02	3.865+02
5	3.955+02	3.189+02	3.299+02	3.089+02	2.614+02	2.952+02	2.272+02
6	4.561+02	4.671+02	4.736+02	4.732+02	3.719+02	4.108+02	3.612+02
7	2.232+02	2.511+02	2.493+02	2.430+02	1.996+02	1.315+02	1.704+02
8	1.336+02	1.762+02	1.500+02	1.397+02	1.395+02	1.213+02	1.069+02
9	1.250+02	1.337+02	1.459+02	1.540+02	1.228+02	1.235+02	9.778+01
10	1.992+02	1.806+02	2.415+02	2.841+02	1.741+02	1.901+02	1.669+02
11	1.473+02	1.742+02	1.692+02	2.311+02	1.681+02	1.576+02	1.003+02
12	2.747+03	2.028+03	1.539+03	1.307+03	8.985+02	7.068+02	5.965+02
13	2.380+03	1.720+03	1.309+03	1.003+03	6.971+02	5.389+02	4.204+02
14	0.	0.	0.	0.	0.	0.	0.
15	0.	0.	0.	0.	0.	0.	0.

TABLE A-8

FLUX IN OUTPUT ENERGY GROUP SHOWN PER 2000 SOURCE
PHOTONS / SQ CM-SEC FROM INPUT ENERGY GROUP 8

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	1.945+02	2.270+02	2.314+02	2.603+02	2.878+02	2.540+02	2.764+02
2	2.345+02	2.589+02	2.937+02	2.933+02	2.578+02	2.822+02	3.295+02
3	2.125+02	2.082+02	2.162+02	2.348+02	2.807+02	2.095+02	2.321+02
4	5.366+02	4.722+02	4.323+02	4.778+02	4.385+02	4.396+02	4.089+02
5	2.699+02	2.718+02	2.770+02	3.063+02	2.892+02	2.416+02	2.281+02
6	4.261+02	3.877+02	3.882+02	3.901+02	3.243+02	3.172+02	2.818+02
7	2.418+02	2.392+02	2.145+02	2.339+02	1.974+02	1.994+02	1.806+02
8	1.504+02	1.338+02	1.150+02	1.284+02	1.852+02	1.069+02	1.272+02
9	1.704+02	1.921+02	1.732+02	1.571+02	1.432+02	1.410+02	8.301+01
10	1.706+02	1.337+02	1.340+02	1.395+02	1.696+02	1.226+02	1.161+02
11	9.698+01	9.621+01	9.851+01	1.581+02	1.250+02	9.665+01	9.652+01
12	2.663+02	2.356+02	3.036+02	2.638+02	2.135+02	1.866+02	1.448+02
13	8.240+02	6.997+02	5.712+02	4.237+02	3.455+02	2.792+02	2.473+02
14	4.693+03	3.443+03	2.604+03	2.006+03	1.479+03	1.129+03	9.364+02
15	0.	0.	0.	0.	0.	0.	0.

TABLE A-9

FLUX IN OUTPUT ENERGY GROUP SHOWN PER 2000 SOURCE
PHOTONS / SQ CM-SEC FROM INPUT ENERGY GROUP 9

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	1.511+02	1.736+02	1.658+02	2.012+02	2.639+02	2.260+02	2.253+02
2	2.360+02	2.170+02	2.267+02	2.284+02	2.258+02	2.442+02	2.433+02
3	1.757+02	1.764+02	1.794+02	2.252+02	2.329+02	1.969+02	1.935+02
4	3.665+02	3.895+02	3.951+02	4.437+02	3.663+02	3.903+02	3.830+02
5	2.533+02	2.602+02	2.635+02	2.575+02	2.597+02	2.121+02	2.201+02
6	4.103+02	4.288+02	3.629+02	4.148+02	3.479+02	3.053+02	3.143+02
7	2.389+02	1.787+02	2.262+02	2.185+02	1.918+02	1.304+02	1.225+02
8	1.429+02	1.335+02	1.374+02	1.441+02	9.975+01	1.171+02	1.170+02
9	1.535+02	1.842+02	1.850+02	2.259+02	1.746+02	1.155+02	1.037+02
10	1.181+02	1.217+02	1.107+02	1.642+02	1.169+02	1.094+02	1.145+02
11	1.168+02	1.252+02	1.310+02	1.546+02	1.122+02	9.137+01	8.611+01
12	2.183+02	2.342+02	2.590+02	2.250+02	1.750+02	1.304+02	1.439+02
13	1.376+02	1.043+02	1.129+02	9.924+01	1.196+02	1.059+02	9.486+01
14	5.876+02	4.943+02	4.747+02	2.900+02	2.547+02	2.688+02	2.171+02
15	5.087+03	3.800+03	2.895+03	2.270+03	1.664+03	1.320+03	1.107+03

APPENDIX B

PARAMETRIC DATA IN DIFFERENTIAL FORM
(Computer Printout)

TABLE B-1

DIFFERENTIAL ENERGY SPECTRUM OF THE NUMBER FLUX PER SOURCE PHOTON / SQ CM-SEC INPUT FROM ENERGY GROUP 1

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	2.166+01	2.211+01	2.283+01	2.417+01	2.001+01	1.703+01	1.462+01
2	5.697+01	4.605+01	4.025+01	3.075+01	2.195+01	1.552+01	1.299+01
3	5.272+01	3.933+01	2.933+01	2.043+01	1.285+01	8.090+00	6.288+00
4	9.431+00	7.488+00	4.654+00	3.655+00	1.782+00	1.077+00	8.183-01
5	0.	0.	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	0.	0.	0.
7	0.	0.	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.
13	0.	0.	0.	0.	0.	0.	0.
14	0.	0.	0.	0.	0.	0.	0.
15	0.	0.	0.	0.	0.	0.	0.

TABLE B-2

DIFFERENTIAL ENERGY SPECTRUM OF THE NUMBER FLUX PER SOURCE PHOTON / SQ CM-SEC INPUT FROM ENERGY GROUP 2

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	1.017+01	1.087+01	1.056+01	1.241+01	1.434+01	1.424+01	1.326+01
2	1.661+01	1.708+01	1.608+01	1.669+01	1.795+01	1.651+01	1.394+01
3	2.171+01	1.931+01	1.944+01	1.638+01	1.554+01	1.335+01	1.105+01
4	3.418+01	2.431+01	2.002+01	1.619+01	1.156+01	9.383+00	6.483+00
5	2.135+01	1.568+01	1.059+01	7.585+00	4.533+00	2.866+00	1.953+00
6	0.	0.	0.	0.	0.	0.	0.
7	0.	0.	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.
13	0.	0.	0.	0.	0.	0.	0.
14	0.	0.	0.	0.	0.	0.	0.
15	0.	0.	0.	0.	0.	0.	0.

TABLE B-3

DIFFERENTIAL ENERGY SPECTRUM OF THE NUMBER FLUX PER SOURCE PHOTON / SQ CM-SEC INPUT FROM ENERGY GROUP 3

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	7.305+00	8.840+00	9.222+00	1.035+01	1.056+01	1.101+01	1.135+01
2	1.301+01	1.391+01	1.435+01	1.305+01	1.313+01	1.365+01	1.130+01
3	1.110+01	1.151+01	1.284+01	1.240+01	1.246+01	9.625+00	9.800+00
4	1.289+01	1.196+01	1.268+01	1.172+01	9.043+00	6.205+00	6.904+00
5	1.013+01	8.937+00	8.145+00	7.416+00	6.331+00	4.720+00	4.313+00
6	1.978+01	1.561+01	1.018+01	7.510+00	4.841+00	3.208+00	2.415+00
7	0.	0.	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.
13	0.	0.	0.	0.	0.	0.	0.
14	0.	0.	0.	0.	0.	0.	0.
15	0.	0.	0.	0.	0.	0.	0.

TABLE B-4

DIFFERENTIAL ENERGY SPECTRUM OF THE NUMBER FLUX PER SOURCE PHOTON / SQ CM-SEC INPUT FROM ENERGY GROUP 4

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	6.270+00	6.513+00	6.270+00	7.875+00	9.102+00	9.977+00	1.061+01
2	1.082+01	1.019+01	1.138+01	1.140+01	1.009+01	1.007+01	1.005+01
3	7.752+00	9.173+00	8.543+00	8.005+00	1.033+01	8.945+00	8.000+00
4	8.341+00	7.754+00	8.053+00	8.352+00	6.741+00	6.070+00	5.907+00
5	6.938+00	6.638+00	6.957+00	6.364+00	4.978+00	4.349+00	3.571+00
6	5.210+00	5.205+00	4.483+00	3.831+00	3.251+00	2.480+00	2.252+00
7	1.419+01	1.012+01	7.575+00	5.540+00	3.765+00	2.723+00	2.098+00
8	7.275+00	5.080+00	3.731+00	2.669+00	1.665+00	1.185+00	8.830-01
9	0.	0.	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.
13	0.	0.	0.	0.	0.	0.	0.
14	0.	0.	0.	0.	0.	0.	0.
15	0.	0.	0.	0.	0.	0.	-0.

TABLE B-5

DIFFERENTIAL ENERGY SPECTRUM OF THE NUMBER FLUX PER SOURCE PHOTON / SQ CM-SEC INPUT FROM ENERGY GROUP 5

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	6.023+00	6.513+00	6.890+00	6.928+00	8.650+00	7.960+00	6.952+00
2	8.352+00	8.035+00	9.135+00	8.750+00	9.913+00	9.885+00	8.562+00
3	9.273+00	7.865+00	1.088+01	8.352+00	8.878+00	7.610+00	8.575+00
4	5.688+00	5.757+00	6.433+00	5.702+00	6.544+00	6.776+00	5.383+00
5	1.032+01	5.635+00	5.338+00	5.052+00	4.302+00	4.888+00	3.534+00
6	3.338+00	3.409+00	3.039+00	3.120+00	2.470+00	2.353+00	1.972+00
7	1.704+00	1.588+00	1.941+00	1.499+00	1.763+00	1.398+00	1.552+00
8	3.944+00	3.185+00	2.792+00	2.435+00	1.701+00	1.524+00	1.229+00
9	9.735+00	7.100+00	4.914+00	3.742+00	2.951+00	1.943+00	1.513+00
10	5.320+00	3.850+00	2.805+00	2.059+00	1.388+00	1.007+00	7.488-01
11	0.	0.	0.	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.
13	0.	0.	0.	0.	0.	0.	0.
14	0.	0.	0.	0.	0.	0.	0.
15	0.	0.	0.	0.	0.	0.	0.

TABLE 3-6

DIFFERENTIAL ENERGY SPECTRUM OF THE NUMBER FLUX PER SOURCE PHOTON / SQ CM-SEC INPUT FROM ENERGY GROUP 6

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	4.733+00	5.640+00	5.065+00	6.035+00	6.377+00	7.195+00	7.695+00
2	6.522+00	7.088+00	9.670+00	7.285+00	7.533+00	8.717+00	7.233+00
3	7.133+00	6.930+00	7.298+00	6.192+00	6.627+00	6.035+00	5.608+00
4	5.283+00	5.140+00	6.084+00	5.791+00	5.944+00	5.191+00	5.130+00
5	3.798+00	3.698+00	4.110+00	3.703+00	3.811+00	3.033+00	3.131+00
6	2.700+00	2.862+00	2.986+00	2.405+00	2.183+00	2.015+00	1.841+00
7	1.473+00	1.578+00	1.160+00	1.134+00	1.289+00	1.426+00	1.072+00
8	1.142+00	1.033+00	1.398+00	1.047+00	1.170+00	7.775-01	6.790-01
9	7.460-01	9.255-01	7.535-01	7.270-01	7.490-01	5.540-01	5.600-01
10	2.342+00	1.874+00	1.602+00	1.302+00	1.078+00	8.110-01	7.625-01
11	6.830+00	4.668+00	3.360+00	2.523+00	1.693+00	1.236+00	9.710-01
12	1.441+00	1.081+00	7.955-01	5.946-01	4.579-01	3.034-01	2.317-01
13	0.	0.	0.	0.	0.	0.	0.
14	0.	0.	0.	0.	0.	0.	0.
15	0.	0.	0.	0.	0.	0.	0.

TABLE B-7

DIFFERENTIAL ENERGY SPECTRUM OF THE NUMBER FLUX PER SOURCE PHOTON / SQ CM-SEC INPUT FROM ENERGY GROUP 7

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	4.402+00	4.655+00	4.868+00	5.[illegible]27+00	5.025+00	5.053+00	6.933+00
2	8.072+00	7.155+00	7.683+00	7.170+00	7.717+00	6.590+00	6.590+00
3	6.063+00	5.725+00	7.715+00	7.403+00	5.813+00	5.390+00	5.105+00
4	4.515+00	4.992+00	4.389+00	4.413+00	4.415+00	4.613+00	3.865+00
5	3.955+00	3.189+00	3.299+00	3.089+00	2.614+00	2.952+00	2.272+00
6	2.280+00	2.336+00	2.363+00	2.366+00	1.860+00	2.054+00	1.806+00
7	1.116+00	1.256+00	1.247+00	1.215+00	9.980-01	9.075-01	8.520-01
8	6.680-01	3.810-01	7.500-01	6.985-01	6.975-01	6.065-01	5.345-01
9	6.250-01	6.685-01	7.295-01	7.700-01	6.140-01	6.175-01	4.889-01
10	4.980-01	4.515-01	6.038-01	7.102-01	4.352-01	4.752-01	4.172-01
11	3.683-01	4.355-01	4.230-01	5.777-01	4.202-01	3.940-01	2.507-01
12	2.747+00	2.028+00	1.539+00	1.307+00	3.985-01	7.068-01	5.965-01
13	2.380+00	1.720+00	1.309+00	1.003+00	6.971-01	5.389-01	4.204-01
14	0.	0.	0.	0.	0.	0.	0.
15	0.	0.	0.	0.	0.	0.	0.

TABLE B-8

DIFFERENTIAL ENERGY SPECTRUM OF THE NUMBER FLUX PER
SOURCE PHOTON / SQ CM-SEC INPUT FROM ENERGY GROUP 8

OUTPUT ENERGY GROUP	3 FT	10 FT	25 FT	ALTITUDE 50 FT	100 FT	150 FT	200 FT
1	4.863+00	5.675+00	5.785+00	6.508+00	7.195+00	6.350+00	6.910+00
2	5.863+00	6.472+00	7.342+00	7.333+00	6.445+00	7.055+00	8.238+00
3	5.313+00	5.205+00	5.405+00	5.870+00	7.017+00	5.238+00	5.803+00
4	5.366+00	4.722+00	4.323+00	4.778+00	4.385+00	4.396+00	4.089+00
5	2.699+00	2.718+00	2.770+00	3.063+00	2.392+00	2.416+00	2.281+00
6	2.130+00	1.939+00	1.941+00	1.950+00	1.622+00	1.586+00	1.409+00
7	1.209+00	1.196+00	1.073+00	1.170+00	9.370-01	9.970-01	9.030-01
8	7.520-01	6.690-01	5.750-01	6.420-01	9.260-01	5.345-01	6.360-01
9	8.520-01	9.605-01	8.660-01	7.855-01	7.160-01	7.050-01	4.150-01
10	4.265-01	3.342-01	3.350-01	3.498-01	4.240-01	3.065-01	2.902-01
11	2.424-01	2.405-01	2.463-01	3.952-01	3.125-01	2.416-01	2.413-01
12	2.663-01	2.356-01	3.036-01	2.633-01	2.135-01	1.866-01	1.448-01
13	8.240-01	6.997-01	5.712-01	4.237-01	3.455-01	2.792-01	2.473-01
14	2.345+00	1.721+00	1.302+00	1.003+00	7.395-01	5.645-01	4.682-01
15	0.	0.	0.	0.	0.	0.	0.

TABLE 3-9

DIFFERENTIAL ENERGY SPECTRUM OF THE NUMBER FLUX PER SOURCE PHOTON / SQ CM-SEC INPUT FROM ENERGY GROUP 9

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	3.778+00	4.340+00	4.145+00	5.030+00	6.597+00	5.650+00	5.632+00
2	5.900+00	5.425+00	5.668+00	5.710+00	5.670+00	6.105+00	6.083+00
3	4.392+00	4.410+00	4.485+00	5.630+00	5.823+00	4.923+00	4.838+00
4	3.665+00	3.895+00	3.951+00	4.437+00	3.663+00	3.903+00	3.830+00
5	2.533+00	2.602+00	2.635+00	2.575+00	2.597+00	2.121+00	2.201+00
6	2.051+00	2.144+00	1.815+00	2.074+00	1.740+00	1.527+00	1.572+00
7	1.194+00	3.935-01	1.131+00	1.093+00	9.590-01	6.520-01	6.125-01
8	7.145-01	6.675-01	6.370-01	7.205-01	4.938-01	5.855-01	5.850-01
9	7.675-01	9.210-01	9.250-01	1.130+00	8.730-01	5.775-01	5.185-01
10	2.952-01	3.043-01	2.768-01	4.105-01	2.922-01	2.735-01	2.863-01
11	2.920-01	3.130-01	3.275-01	3.865-01	2.805-01	2.284-01	2.153-01
12	2.183-01	2.342-01	2.590-01	2.250-01	1.750-01	1.304-01	1.439-01
13	1.376-01	1.043-01	1.129-01	9.924-02	1.196-01	1.059-01	9.436-02
14	2.938-01	2.471-01	2.373-01	1.450-01	1.271-01	1.344-01	1.085-01
15	2.543+00	1.900+00	1.447+00	1.135+00	8.320-01	6.600-01	5.535-01

APPENDIX C

FALLOUT NUMBER SPECTRA IN DIFFERENTIAL FORM
(Computer Printout)

TABLE C- 1

NUMBER SPECTRA FOR INPUT SPECTRUM 1
PHOTONS/MEV-SQ CM-SEC PER 10,000 FISSION PRODUCTS/SQ CM

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	5.393+00	5.909+00	5.882+00	6.729+00	7.318+00	7.431+00	7.882+00
2	8.626+00	8.372+00	9.410+00	8.683+00	8.740+00	8.665+00	8.035+00
3	7.977+00	7.667+00	8.605+00	7.593+00	7.850+00	6.787+00	6.582+00
4	7.000+00	6.654+00	6.588+00	6.176+00	5.734+00	5.429+00	4.773+00
5	6.235+00	4.858+00	4.728+00	4.314+00	3.658+00	3.413+00	2.827+00
6	3.377+00	3.291+00	2.960+00	2.663+00	2.173+00	1.969+00	1.729+00
7	3.560+00	2.842+00	2.344+00	1.885+00	1.572+00	1.321+00	1.145+00
8	2.492+00	1.970+00	1.683+00	1.349+00	1.078+00	8.282-01	6.925-01
9	2.129+00	1.704+00	1.279+00	1.063+00	8.637-01	6.605-01	5.295-01
10	1.569+00	1.193+00	9.843-01	8.159-01	5.950-01	4.731-01	4.025-01
11	1.422+00	1.020+00	7.651-01	6.511-01	4.484-01	3.482-01	2.647-01
12	9.191-01	6.853-01	5.261-01	4.317-01	3.090-01	2.337-01	1.915-01
13	6.062-01	4.470-01	3.436-01	2.621-01	1.866-01	1.453-01	1.159-01
14	2.014-01	1.478-01	1.119-01	8.612-02	6.352-02	4.354-02	4.025-02
15	3.248-03	2.426-03	1.848-03	1.449-03	1.062-03	8.428-04	7.068-04

TABLE C- 2

NUMBER SPECTRA FOR INPUT SPECTRUM 2
PHOTONS/MEV-SQ CM-SEC PER 10,000 FISSION PRODUCTS/SQ CM

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	1.766+00	1.947+00	1.932+00	2.189+00	2.402+00	2.438+00	2.527+00
2	2.793+00	2.727+00	3.099+00	2.806+00	2.850+00	2.863+00	2.593+00
3	2.677+00	2.530+00	2.849+00	2.458+00	2.549+00	2.204+00	2.158+00
4	2.231+00	2.148+00	2.143+00	1.994+00	1.889+00	1.783+00	1.566+00
5	2.082+00	1.578+00	1.538+00	1.401+00	1.206+00	1.125+00	9.379-01
6	1.113+00	1.084+00	9.720-01	8.686-01	7.098-01	6.405-01	5.609-01
7	1.024+00	8.327-01	6.981-01	5.637-01	4.952-01	4.234-01	3.706-01
8	7.973-01	6.338-01	5.595-01	4.503-01	3.614-01	2.798-01	2.328-01
9	8.495-01	6.689-01	4.903-01	3.998-01	3.244-01	2.394-01	1.949-01
10	6.314-01	4.771-01	3.834-01	3.078-01	2.254-01	1.743-01	1.474-01
11	5.883-01	4.131-01	3.046-01	2.465-01	1.691-01	1.275-01	9.810-02
12	2.686-01	2.005-01	1.525-01	1.230-01	8.922-02	6.585-02	5.333-02
13	1.410-01	1.039-01	7.985-02	6.092-02	4.334-02	3.374-02	2.689-02
14	4.528-02	3.323-02	2.515-02	1.936-02	1.428-02	1.091-02	9.051-03
15	7.642-04	5.709-04	4.349-04	3.410-04	2.500-04	1.983-04	1.663-04

TABLE C- 3

NUMBER SPECTRA FOR INPUT SPECTRUM 3
PHOTONS/MEV-SQ CM-SEC PER 10,000 FISSION PRODUCTS/SQ CM

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	6.537-01	7.301-01	7.202-01	8.100-01	8.965-01	9.169-01	9.301-01
2	1.014+00	1.006+00	1.166+00	1.030+00	1.057+00	1.037+00	9.564-01
3	1.004+00	9.436-01	1.066+00	9.046-01	9.476-01	8.186-01	8.092-01
4	8.068-01	7.956-01	8.055-01	7.471-01	7.193-01	6.737-01	5.952-01
5	7.855-01	5.888-01	5.783-01	5.269-01	4.642-01	4.263-01	3.624-01
6	4.673-01	4.455-01	3.890-01	3.389-01	2.749-01	2.433-01	2.117-01
7	3.255-01	2.719-01	2.307-01	1.874-01	1.755-01	1.542-01	1.350-01
8	2.342-01	2.270-01	2.092-01	1.632-01	1.366-01	1.058-01	8.761-02
9	3.564-01	2.790-01	2.011-01	1.621-01	1.322-01	9.460-02	7.867-02
10	2.757-01	2.087-01	1.649-01	1.292-01	9.563-02	7.216-02	6.114-02
11	2.387-01	1.994-01	1.448-01	1.120-01	7.564-02	5.612-02	4.367-02
12	8.301-02	6.582-02	4.931-02	3.853-02	2.364-02	2.022-02	1.601-02
13	2.616-02	1.923-02	1.476-02	1.127-02	7.935-03	6.220-03	4.946-03
14	7.423-03	5.448-03	4.124-03	3.174-03	2.342-03	1.790-03	1.484-03
15	1.720-04	1.284-04	9.786-05	7.673-05	5.625-05	4.462-05	3.742-05

TABLE C- 4

NUMBER SPECTRA FOR INPUT SPECTRUM 4
PHOTONS/MEV-SQ CM-SEC PER 10,000 FISSION PRODUCTS/SQ CM

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	2.796-01	3.159-01	3.096-01	3.483-01	3.853-01	3.975-01	4.040-01
2	4.224-01	4.265-01	5.054-01	4.389-01	4.556-01	4.773-01	4.141-01
3	4.268-01	4.023-01	4.603-01	3.902-01	4.097-01	3.547-01	3.517-01
4	3.447-01	3.472-01	3.532-01	3.269-01	3.139-01	2.974-01	2.643-01
5	3.376-01	2.545-01	2.518-01	2.293-01	2.059-01	1.870-01	1.619-01
6	2.127-01	2.014-01	1.754-01	1.509-01	1.223-01	1.084-01	9.421-02
7	1.174-01	1.026-01	8.810-02	7.332-02	7.247-02	6.596-02	5.751-02
8	1.120-01	9.117-02	8.781-02	7.073-02	5.951-02	4.581-02	3.814-02
9	1.551-01	1.226-01	8.353-02	7.171-02	5.915-02	4.220-02	3.563-02
10	1.281-01	9.706-02	7.705-02	6.041-02	4.515-02	3.399-02	2.910-02
11	1.528-01	1.052-01	7.619-02	5.833-02	3.931-02	2.903-02	2.263-02
12	4.233-02	3.166-02	2.358-02	1.824-02	1.365-02	9.496-03	7.465-03
13	9.508-03	6.956-03	5.326-03	4.070-03	2.871-03	2.229-03	1.763-03
14	1.912-03	1.404-03	1.062-03	8.178-04	6.032-04	4.610-04	3.823-04
15	3.821-05	2.354-05	2.175-05	1.705-05	1.250-05	9.915-06	8.315-06

TABLE C- 5

NUMBER SPECTRA FOR INPUT SPECTRUM 5
PHOTONS/MEV-SQ CM-SEC PER 10,000 FISSION PRODUCTS/SQ CM

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	1.042-01	1.174-01	1.156-01	1.291-01	1.440-01	1.475-01	1.477-01
2	1.579-01	1.590-01	1.867-01	1.630-01	1.703-01	1.773-01	1.528-01
3	1.619-01	1.511-01	1.734-01	1.455-01	1.522-01	1.317-01	1.313-01
4	1.309-01	1.298-01	1.319-01	1.212-01	1.131-01	1.104-01	9.702-02
5	1.311-01	9.631-02	9.394-02	8.523-02	7.539-02	6.943-02	5.938-02
6	7.836-02	7.399-02	6.394-02	5.520-02	4.452-02	3.932-02	3.404-02
7	4.118-02	3.609-02	3.158-02	2.607-02	2.627-02	2.370-02	2.100-02
8	4.229-02	3.431-02	3.286-02	2.661-02	2.193-02	1.712-02	1.417-02
9	6.374-02	4.964-02	3.549-02	2.841-02	2.318-02	1.634-02	1.371-02
10	4.986-02	3.755-02	2.944-02	2.283-02	1.690-02	1.263-02	1.069-02
11	5.290-02	3.633-02	2.626-02	1.997-02	1.344-02	9.891-03	7.719-03
12	1.366-02	1.022-02	7.571-03	5.807-03	4.372-03	3.004-03	2.347-03
13	2.270-03	1.648-03	1.256-03	9.618-04	6.720-04	5.203-04	4.079-04
14	1.611-04	1.182-04	8.940-05	6.887-05	5.078-05	3.876-05	3.215-05
15	0.	0.	0.	0.	0.	0.	0.

TABLE C- 6

NUMBER SPECTRA FOR INPUT SPECTRUM 6
PHOTONS/MEV-SQ CM-SEC PER 10,000 FISSION PRODUCTS/SQ CM

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	3.867-02	4.322-02	4.295-02	4.820-02	5.320-02	5.422-02	5.416-02
2	6.196-02	6.158-02	6.997-02	6.172-02	6.320-02	6.425-02	5.571-02
3	6.189-02	5.793-02	6.442-02	5.476-02	5.666-02	4.827-02	4.739-02
4	5.423-02	5.064-02	5.054-02	4.614-02	4.235-02	3.920-02	3.388-02
5	4.973-02	3.732-02	3.507-02	3.140-02	2.639-02	2.402-02	2.026-02
6	3.264-02	2.955-02	2.398-02	2.025-02	1.579-02	1.336-02	1.142-02
7	1.668-02	1.375-02	1.170-02	9.361-03	8.750-03	7.566-03	6.679-03
8	1.481-02	1.172-02	1.067-02	8.566-03	6.765-03	5.302-03	4.342-03
9	1.902-02	1.468-02	1.048-02	8.350-03	6.749-03	4.757-03	3.952-03
10	1.417-02	1.063-02	8.300-03	6.428-03	4.707-03	3.526-03	2.953-03
11	1.329-02	9.145-03	6.623-03	5.066-03	3.413-03	2.522-03	1.962-03
12	3.732-03	2.789-03	2.071-03	1.603-03	1.197-03	8.327-04	6.556-04
13	8.399-04	6.089-04	4.641-04	3.554-04	2.479-04	1.919-04	1.502-04
14	4.324-05	3.173-05	2.400-05	1.848-05	1.363-05	1.040-05	8.629-06
15	0.	0.	0.	0.	0.	0.	0.

TABLE C- 7

NUMBER SPECTRA FOR INPUT SPECTRUM 7
PHOTONS/MEV-SQ CM-SEC PER 10,000 FISSION PRODUCTS/SQ CM

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	1.558-02	1.730-02	1.733-02	1.963-02	2.096-02	2.128-02	2.164-02
2	2.680-02	2.622-02	2.791-02	2.535-02	2.541-02	2.500-02	2.185-02
3	2.600-02	2.425-02	2.599-02	2.258-02	2.246-02	1.885-02	1.803-02
4	2.432-02	2.157-02	2.090-02	1.889-02	1.621-02	1.480-02	1.255-02
5	1.952-02	1.525-02	1.376-02	1.210-02	9.986-03	8.578-03	7.208-03
6	1.422-02	1.237-02	9.506-03	7.815-03	5.856-03	4.791-03	4.036-03
7	5.971-03	4.801-03	3.981-03	3.177-03	2.751-03	2.329-03	2.021-03
8	4.491-03	3.550-03	3.113-03	2.477-03	1.948-03	1.517-03	1.244-03
9	4.419-03	3.472-03	2.542-03	2.076-03	1.682-03	1.233-03	1.019-03
10	3.353-03	2.538-03	2.046-03	1.645-03	1.191-03	9.274-04	7.842-04
11	3.260-03	2.287-03	1.682-03	1.349-03	9.163-04	6.965-04	5.297-04
12	1.530-03	1.138-03	8.547-04	6.887-04	4.967-04	3.649-04	2.965-04
13	7.628-04	5.532-04	4.217-04	3.229-04	2.254-04	1.744-04	1.366-04
14	4.409-05	3.235-05	2.446-05	1.885-05	1.390-05	1.061-05	8.798-06
15	0.	0.	0.	0.	0.	0.	0.

TABLE C- 8

NUMBER SPECTRA FOR INPUT SPECTRUM 8
PHOTONS/MEV-SQ CM-SEC PER 10,000 FISSION PRODUCTS/SQ CM

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	7.673-03	8.422-03	8.472-03	9.563-03	1.004-02	1.007-02	1.035-02
2	1.352-02	1.294-02	1.358-02	1.232-02	1.234-02	1.184-02	1.045-02
3	1.312-02	1.195-02	1.281-02	1.105-02	1.060-02	8.948-03	8.501-03
4	1.166-02	1.026-02	9.772-03	8.737-03	7.551-03	6.963-03	5.831-03
5	9.202-03	7.066-03	6.310-03	5.522-03	4.514-03	3.938-03	3.288-03
6	5.656-03	5.015-03	3.992-03	3.379-03	2.565-03	2.206-03	1.875-03
7	2.452-03	2.048-03	1.756-03	1.441-03	1.268-03	1.089-03	9.667-04
8	1.942-03	1.596-03	1.408-03	1.146-03	9.266-04	7.355-04	6.107-04
9	2.172-03	1.719-03	1.285-03	1.067-03	8.593-04	6.504-04	5.308-04
10	1.597-03	1.214-03	1.004-03	8.335-04	5.917-04	4.770-04	4.032-04
11	1.405-03	1.010-03	7.573-04	6.410-04	4.397-04	3.443-04	2.558-04
12	1.007-03	7.473-04	5.645-04	4.640-04	3.289-04	2.482-04	2.046-04
13	6.442-04	4.674-04	3.553-04	2.728-04	1.905-04	1.474-04	1.155-04
14	3.985-05	2.924-05	2.211-05	1.703-05	1.256-05	9.587-06	7.952-06
15	0.	0.	0.	0.	0.	0.	0.

TABLE C-10

NUMBER SPECTRA FOR INPUT SPECTRUM 10
PHOTONS/MEV-SQ CM-SEC PER 10,000 FISSION PRODUCTS/SQ CM

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	1.451-03	1.594-03	1.575-03	1.781-03	1.911-03	1.925-03	1.952-03
2	2.431-03	2.353-03	2.550-03	2.279-03	2.326-03	2.273-03	1.985-03
3	2.511-03	2.260-03	2.433-03	2.048-03	1.938-03	1.713-03	1.616-03
4	2.260-03	1.983-03	1.853-03	1.640-03	1.474-03	1.345-03	1.135-03
5	1.795-03	1.342-03	1.190-03	1.027-03	8.514-04	7.568-04	6.303-04
6	6.920-04	6.695-04	6.026-04	5.318-04	4.330-04	3.980-04	3.476-04
7	4.196-04	3.727-04	3.243-04	2.741-04	2.640-04	2.393-04	2.105-04
8	3.861-04	3.229-04	3.068-04	2.498-04	2.124-04	1.655-04	1.385-04
9	5.219-04	4.169-04	3.077-04	2.540-04	2.087-04	1.538-04	1.288-04
10	4.275-04	3.257-04	2.651-04	2.143-04	1.574-04	1.226-04	1.051-04
11	4.959-04	3.464-04	2.539-04	2.016-04	1.367-04	1.033-04	7.898-05
12	2.115-04	1.574-04	1.181-04	9.460-05	6.858-05	5.000-05	4.045-05
13	9.705-05	7.043-05	5.371-05	4.111-05	2.872-05	2.224-05	1.743-05
14	6.614-06	4.852-06	3.670-06	2.827-06	2.084-06	1.591-06	1.320-06
15	0.	0.	0.	0.	0.	0.	0.

TABLE C-11

NUMBER SPECTRA FOR INPUT SPECTRUM 11
PHOTONS/MEV-SQ CM-SEC PER 10,000 FISSION PRODUCTS/SQ CM

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	4.656-04	5.245-04	5.033-04	5.722-04	6.255-04	6.469-04	6.467-04
2	7.219-04	7.272-04	8.455-04	7.182-04	7.446-04	7.717-04	6.533-04
3	7.949-04	7.197-04	7.732-04	6.389-04	6.445-04	5.636-04	5.334-04
4	6.986-04	6.421-04	6.064-04	5.415-04	5.105-04	4.573-04	4.018-04
5	5.598-04	4.263-04	3.923-04	3.395-04	3.006-04	2.570-04	2.292-04
6	2.063-04	2.103-04	2.038-04	1.753-04	1.504-04	1.390-04	1.235-04
7	1.077-04	1.078-04	9.222-05	8.256-05	9.166-05	9.115-05	7.676-05
8	1.205-04	1.028-04	1.117-04	8.926-05	8.284-05	6.151-05	5.209-05
9	1.860-04	1.537-04	1.122-04	9.301-05	7.984-05	5.697-05	5.017-05
10	1.900-04	1.458-04	1.177-04	9.282-05	7.164-05	5.369-05	4.735-05
11	3.114-04	2.133-04	1.538-04	1.162-04	7.811-05	5.724-05	4.484-05
12	7.242-05	5.426-05	4.010-05	3.037-05	2.313-05	1.562-05	1.207-05
13	6.234-06	4.544-06	3.472-06	2.656-06	1.864-06	1.446-06	1.139-06
14	8.649-07	6.346-07	4.799-07	3.697-07	2.726-07	2.081-07	1.726-07
15	0.	0.	0.	0.	0.	0.	0.

APPENDIX D

FALLOUT DOSE-RATE SPECTRA IN MULTIGROUP FORM
(Computer Printout)

TABLE D- 1

MULTIGROUP DOSE RATES FOR INPUT SPECTRUM 1
MR/HR PER 10,000 FISSION PRODUCTS/SQ CM

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	1.338-05	1.465-05	1.459-05	1.669-05	1.815-05	1.843-05	1.955-05
2	1.967-05	1.909-05	2.146-05	1.980-05	1.993-05	1.976-05	1.832-05
3	2.090-05	2.009-05	2.254-05	1.989-05	2.057-05	1.778-05	1.725-05
4	6.510-05	6.188-05	6.127-05	5.743-05	5.333-05	5.049-05	4.439-05
5	8.885-05	6.922-05	6.737-05	6.148-05	5.213-05	4.864-05	4.028-05
6	1.472-04	1.435-04	1.290-04	1.161-04	9.475-05	8.584-05	7.540-05
7	2.261-04	1.804-04	1.488-04	1.197-04	9.984-05	8.386-05	7.269-05
8	2.036-04	1.610-04	1.375-04	1.102-04	8.810-05	6.766-05	5.657-05
9	2.151-04	1.721-04	1.292-04	1.074-04	8.724-05	6.671-05	5.348-05
10	3.922-04	2.982-04	2.461-04	2.040-04	1.488-04	1.183-04	1.006-04
11	4.494-04	3.222-04	2.418-04	2.058-04	1.417-04	1.100-04	8.366-05
12	9.486-04	7.072-04	5.429-04	4.455-04	3.189-04	2.412-04	1.976-04
13	8.092-04	5.968-04	4.586-04	3.499-04	2.491-04	1.940-04	1.547-04
14	6.929-04	5.085-04	3.848-04	2.963-04	2.185-04	1.670-04	1.385-04
15	1.432-05	1.070-05	8.151-06	6.392-06	4.685-06	3.717-06	3.117-06

TABLE D- 2

MULTIGROUP DOSE RATES FOR INPUT SPECTRUM 2
MR/HR PER 10,000 FISSION PRODUCTS/SQ CM

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	4.380-06	4.829-06	4.792-06	5.428-06	5.957-06	6.046-06	6.266-06
2	6.369-06	6.218-06	7.065-06	6.399-06	6.498-06	6.527-06	5.913-06
3	7.014-06	6.630-06	7.464-06	6.441-06	6.679-06	5.774-06	5.654-06
4	2.075-05	1.997-05	1.993-05	1.855-05	1.757-05	1.658-05	1.456-05
5	2.967-05	2.249-05	2.191-05	1.997-05	1.719-05	1.603-05	1.337-05
6	4.855-05	4.723-05	4.238-05	3.787-05	3.035-05	2.793-05	2.445-05
7	6.500-05	5.288-05	4.433-05	3.579-05	3.145-05	2.639-05	2.354-05
8	6.514-05	5.178-05	4.571-05	3.679-05	2.952-05	2.286-05	1.902-05
9	8.580-05	6.756-05	4.952-05	4.038-05	3.277-05	2.418-05	1.968-05
10	1.579-04	1.193-04	9.584-05	7.696-05	5.635-05	4.357-05	3.685-05
11	1.859-04	1.306-04	9.626-05	7.788-05	5.311-05	4.030-05	3.100-05
12	2.772-04	2.069-04	1.574-04	1.269-04	9.208-05	6.796-05	5.504-05
13	1.883-04	1.387-04	1.066-04	8.133-05	5.786-05	4.504-05	3.590-05
14	1.558-04	1.143-04	8.651-05	6.661-05	4.913-05	3.754-05	3.113-05
15	3.370-06	2.518-06	1.913-06	1.504-06	1.102-06	8.745-07	7.334-07

TABLE D- 3

MULTIGROUP DOSE RATES FOR INPUT SPECTRUM 3
MR/HR PER 10,000 FISSION PRODUCTS/SQ CM

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	1.621-06	1.811-06	1.786-06	2.009-06	2.223-06	2.274-06	2.307-06
2	2.311-06	2.293-06	2.659-06	2.349-06	2.411-06	2.479-06	2.181-06
3	2.630-06	2.472-06	2.794-06	2.370-06	2.483-06	2.145-06	2.120-06
4	7.503-06	7.399-06	7.491-06	6.948-06	6.689-06	6.265-06	5.535-06
5	1.119-05	8.391-06	8.241-06	7.508-06	6.614-06	6.075-06	5.165-06
6	2.037-05	1.942-05	1.696-05	1.478-05	1.199-05	1.061-05	9.231-06
7	2.067-05	1.727-05	1.465-05	1.190-05	1.114-05	9.789-06	8.574-06
8	2.322-05	1.855-05	1.709-05	1.374-05	1.116-05	8.646-06	7.158-06
9	3.600-05	2.818-05	2.031-05	1.637-05	1.336-05	9.555-06	7.945-06
10	6.918-05	5.217-05	4.123-05	3.231-05	2.391-05	1.804-05	1.528-05
11	9.124-05	6.300-05	4.577-05	3.539-05	2.390-05	1.774-05	1.380-05
12	9.083-05	6.793-05	5.089-05	3.976-05	2.955-05	2.087-05	1.653-05
13	3.492-05	2.567-05	1.971-05	1.504-05	1.067-05	8.303-06	6.603-06
14	2.554-05	1.874-05	1.419-05	1.092-05	8.055-06	6.158-06	5.107-06
15	7.583-07	5.665-07	4.315-07	3.384-07	2.480-07	1.968-07	1.650-07

TABLE D- 4

MULTIGROUP DOSE RATES FOR INPUT SPECTRUM 4
MR/HR PER 10,000 FISSION PRODUCTS/SQ CM

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	6.934-07	7.835-07	7.678-07	8.638-07	9.556-07	9.859-07	1.002-06
2	9.630-07	9.724-07	1.152-06	1.001-06	1.041-06	1.088-06	9.441-07
3	1.119-06	1.054-06	1.206-06	1.022-06	1.071-06	9.294-07	9.215-07
4	3.206-06	3.229-06	3.285-06	3.040-06	2.965-06	2.766-06	2.458-06
5	4.811-06	3.627-06	3.588-06	3.268-06	2.934-06	2.664-06	2.307-06
6	9.274-06	8.780-06	7.650-06	6.580-06	5.333-06	4.724-06	4.108-06
7	7.456-06	6.517-06	5.595-06	4.656-06	4.602-06	4.188-06	3.652-06
8	9.151-06	7.449-06	7.174-06	5.779-06	4.862-06	3.742-06	3.116-06
9	1.566-05	1.238-05	8.942-06	7.293-06	5.974-06	4.262-06	3.598-06
10	3.203-05	2.426-05	1.926-05	1.510-05	1.129-05	8.497-06	7.275-06
11	4.829-05	3.323-05	2.407-05	1.843-05	1.242-05	9.174-06	7.152-06
12	4.368-05	3.267-05	2.433-05	1.882-05	1.409-05	9.800-06	7.704-06
13	1.269-05	9.286-06	7.110-06	5.433-06	3.832-06	2.976-06	2.354-06
14	6.579-06	4.828-06	3.654-06	2.813-06	2.075-06	1.586-06	1.315-06
15	1.685-07	1.259-07	9.590-08	7.520-08	5.512-08	4.373-08	3.667-08

TABLE D- 5

MULTIGROUP DOSE RATES FOR INPUT SPECTRUM 5
MR/HR PER 10,000 FISSION PRODUCTS/SQ CM

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	2.585-07	2.912-07	2.866-07	3.201-07	3.570-07	3.659-07	3.662-07
2	3.600-07	3.624-07	4.258-07	3.716-07	3.832-07	4.041-07	3.483-07
3	4.242-07	3.958-07	4.544-07	3.811-07	3.937-07	3.452-07	3.439-07
4	1.217-06	1.207-06	1.227-06	1.127-06	1.039-06	1.026-06	9.023-07
5	1.568-06	1.372-06	1.339-06	1.215-06	1.031-06	9.893-07	8.461-07
6	3.417-06	3.226-06	2.788-06	2.407-06	1.941-06	1.714-06	1.484-06
7	2.615-06	2.292-06	2.005-06	1.656-06	1.668-06	1.505-06	1.334-06
8	3.455-06	2.803-06	2.685-06	2.174-06	1.792-06	1.399-06	1.158-06
9	6.438-06	5.014-06	3.585-06	2.870-06	2.341-06	1.650-06	1.384-06
10	1.246-05	9.386-06	7.359-06	5.707-06	4.225-06	3.158-06	2.671-06
11	1.672-05	1.148-05	8.297-06	6.310-06	4.246-06	3.125-06	2.439-06
12	1.409-05	1.054-05	7.313-06	5.993-06	4.512-06	3.100-06	2.422-06
13	3.030-06	2.199-06	1.577-06	1.284-06	8.971-07	6.946-07	5.446-07
14	5.543-07	4.066-07	3.075-07	2.369-07	1.747-07	1.333-07	1.106-07
15	0.	0.	0.	0.	0.	0.	0.

TABLE D- 6

MULTIGROUP DOSE RATES FOR INPUT SPECTRUM 6
MR/HR PER 10,000 FISSION PRODUCTS/SQ CM

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	9.591-08	1.072-07	1.065-07	1.195-07	1.319-07	1.345-07	1.343-07
2	1.413-07	1.404-07	1.573-07	1.407-07	1.441-07	1.465-07	1.270-07
3	1.621-07	1.518-07	1.688-07	1.435-07	1.485-07	1.265-07	1.242-07
4	5.044-07	4.709-07	4.701-07	4.291-07	3.939-07	3.646-07	3.151-07
5	7.086-07	5.319-07	4.997-07	4.474-07	3.832-07	3.423-07	2.887-07
6	1.423-06	1.288-06	1.045-06	8.830-07	6.893-07	5.827-07	4.979-07
7	1.059-06	8.731-07	7.429-07	5.944-07	5.556-07	4.805-07	4.241-07
8	1.210-06	9.572-07	8.721-07	6.998-07	5.527-07	4.332-07	3.547-07
9	1.921-06	1.483-06	1.058-06	8.433-07	6.816-07	4.805-07	3.991-07
10	3.543-06	2.658-06	2.075-06	1.607-06	1.177-06	8.815-07	7.382-07
11	4.199-06	2.890-06	2.093-06	1.601-06	1.078-06	7.968-07	6.198-07
12	3.852-06	2.878-06	2.137-06	1.654-06	1.236-06	8.594-07	6.766-07
13	1.121-06	8.129-07	6.196-07	4.744-07	3.310-07	2.562-07	2.006-07
14	1.488-07	1.091-07	8.254-08	6.359-08	4.688-08	3.579-08	2.968-08
15	0.	0.	0.	0.	0.	0.	0.

TABLE D- 7

MULTIGROUP DOSE RATES FOR INPUT SPECTRUM 7
MR/HR PER 10,000 FISSION PRODUCTS/SQ CM

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	3.864-08	4.290-08	4.298-08	4.869-08	5.198-08	5.278-08	5.366-08
2	6.111-08	5.977-08	6.362-08	5.779-08	5.793-08	5.700-08	4.981-08
3	6.811-08	6.354-08	6.809-08	5.915-08	5.835-08	4.939-08	4.724-08
4	2.262-07	2.006-07	1.944-07	1.757-07	1.507-07	1.377-07	1.167-07
5	2.781-07	2.173-07	1.961-07	1.725-07	1.423-07	1.222-07	1.027-07
6	6.199-07	5.392-07	4.144-07	3.407-07	2.553-07	2.089-07	1.760-07
7	3.791-07	3.049-07	2.528-07	2.018-07	1.747-07	1.479-07	1.283-07
8	3.669-07	2.900-07	2.544-07	2.024-07	1.591-07	1.240-07	1.016-07
9	4.463-07	3.506-07	2.568-07	2.097-07	1.699-07	1.246-07	1.030-07
10	8.382-07	6.345-07	5.115-07	4.113-07	2.977-07	2.318-07	1.961-07
11	1.030-06	7.228-07	5.316-07	4.262-07	2.896-07	2.201-07	1.674-07
12	1.579-06	1.175-06	8.820-07	7.108-07	5.125-07	3.766-07	3.060-07
13	1.018-06	7.385-07	5.630-07	4.310-07	3.009-07	2.329-07	1.824-07
14	1.517-07	1.113-07	8.416-08	6.483-08	4.780-08	3.649-08	3.025-08
15	0.	0.	0.	0.	0.	0.	0.

TABLE D- 8

MULTIGROUP DOSE RATES FOR INPUT SPECTRUM 8
MR/HR PER 10,000 FISSION PRODUCTS/SQ CM

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	1.903-08	2.089-08	2.101-08	2.372-08	2.490-08	2.497-08	2.567-08
2	3.082-08	2.951-08	3.096-08	2.809-08	2.813-08	2.699-08	2.382-08
3	3.437-08	3.132-08	3.356-08	2.895-08	2.778-08	2.344-08	2.227-08
4	1.085-07	9.546-08	9.088-08	8.126-08	7.032-08	6.476-08	5.423-08
5	1.311-07	1.007-07	8.991-08	7.868-08	6.432-08	5.683-08	4.695-08
6	2.466-07	2.187-07	1.740-07	1.473-07	1.119-07	9.617-08	8.173-08
7	1.557-07	1.301-07	1.115-07	9.150-08	8.055-08	6.914-08	6.138-08
8	1.587-07	1.304-07	1.151-07	9.365-08	7.571-08	6.009-08	4.989-08
9	2.193-07	1.736-07	1.298-07	1.078-07	8.679-08	6.569-08	5.361-08
10	3.992-07	3.036-07	2.510-07	2.084-07	1.479-07	1.193-07	1.008-07
11	4.439-07	3.192-07	2.393-07	2.026-07	1.389-07	1.098-07	8.083-08
12	1.039-06	7.712-07	5.826-07	4.789-07	3.395-07	2.562-07	2.112-07
13	8.601-07	6.239-07	4.757-07	3.642-07	2.543-07	1.968-07	1.542-07
14	1.371-07	1.006-07	7.607-08	5.860-08	4.320-08	3.298-08	2.735-08
15	0.	0.	0.	0.	0.	0.	0.

TABLE D- 9

MULTIGROUP DOSE RATES FOR INPUT SPECTRUM 9
MR/HR PER 10,000 FISSION PRODUCTS/SQ CM

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	9.455-09	1.029-08	1.032-08	1.163-08	1.225-08	1.222-08	1.256-08
2	1.520-08	1.441-08	1.522-08	1.376-08	1.383-08	1.319-08	1.170-08
3	1.721-08	1.547-08	1.663-08	1.415-08	1.349-08	1.151-08	1.090-08
4	5.235-08	4.609-08	4.342-08	3.863-08	3.426-08	3.171-08	2.655-08
5	6.422-08	4.819-08	4.307-08	3.759-08	3.074-08	2.795-08	2.277-08
6	9.130-08	8.534-08	7.316-08	6.456-08	5.095-08	4.620-08	3.993-08
7	7.919-08	6.737-08	5.856-08	4.848-08	4.364-08	3.783-08	3.383-08
8	8.507-08	7.059-08	6.310-08	5.168-08	4.218-08	3.359-08	2.797-08
9	1.284-07	1.014-07	7.562-08	6.260-08	5.042-08	3.801-08	3.104-08
10	2.334-07	1.773-07	1.461-07	1.208-07	8.587-08	6.893-08	5.822-08
11	2.593-07	1.859-07	1.391-07	1.171-07	9.026-08	6.266-08	4.667-08
12	5.838-07	4.333-07	3.272-07	2.686-07	1.907-07	1.436-07	1.183-07
13	4.755-07	3.450-07	2.631-07	2.014-07	1.406-07	1.089-07	8.531-08
14	7.875-08	5.778-08	4.370-08	3.366-08	2.482-08	1.895-08	1.571-08
15	0.	0.	0.	0.	0.	0.	0.

TABLE D-10

MULTIGROUP DOSE RATES FOR INPUT SPECTRUM 10
MR/HR PER 10,000 FISSION PRODUCTS/SQ CM

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	3.599-09	3.952-09	3.905-09	4.416-09	4.739-09	4.775-09	4.841-09
2	5.543-09	5.364-09	5.815-09	5.197-09	5.303-09	5.181-09	4.525-09
3	6.580-09	5.920-09	6.374-09	5.367-09	5.209-09	4.489-09	4.234-09
4	2.102-08	1.844-08	1.724-08	1.526-08	1.371-08	1.251-08	1.056-08
5	2.557-08	1.912-08	1.696-08	1.463-08	1.213-08	1.078-08	8.982-09
6	3.017-08	2.919-08	2.627-08	2.319-08	1.888-08	1.735-08	1.516-08
7	2.665-08	2.366-08	2.059-08	1.740-08	1.676-08	1.520-08	1.337-08
8	3.154-08	2.638-08	2.507-08	2.041-08	1.735-08	1.352-08	1.132-08
9	5.272-08	4.211-08	3.108-08	2.565-08	2.107-08	1.554-08	1.300-08
10	1.069-07	8.141-08	6.628-08	5.358-08	3.934-08	3.064-08	2.627-08
11	1.567-07	1.095-07	8.024-08	6.370-08	4.321-08	3.265-08	2.496-08
12	2.182-07	1.625-07	1.219-07	9.762-08	7.077-08	5.160-08	4.175-08
13	1.296-07	9.402-08	7.170-08	5.489-08	3.834-08	2.968-08	2.327-08
14	2.275-08	1.669-08	1.262-08	9.725-09	7.170-09	5.473-09	4.540-09
15	0.	0.	0.	0.	0.	0.	0.

TABLE D-11

MULTIGROUP DOSE RATES FOR INPUT SPECTRUM 11
MR/HR PER 10,000 FISSION PRODUCTS/SQ CM

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	1.155-09	1.301-09	1.248-09	1.419-09	1.551-09	1.604-09	1.604-09
2	1.646-09	1.558-09	1.928-09	1.638-09	1.698-09	1.760-09	1.489-09
3	2.083-09	1.386-09	2.026-09	1.674-09	1.689-09	1.477-09	1.397-09
4	6.497-09	5.972-09	5.639-09	5.036-09	4.748-09	4.253-09	3.737-09
5	7.978-09	6.074-09	5.[illegible]90-09	4.837-09	4.283-09	3.663-09	3.266-09
6	8.996-09	9.170-09	8.883-09	7.642-09	6.559-09	6.062-09	5.386-09
7	6.341-09	6.848-09	5.856-09	5.243-09	5.821-09	5.788-09	4.875-09
8	9.848-09	8.398-09	9.125-09	7.293-09	6.768-09	5.026-09	4.256-09
9	1.879-08	1.552-08	1.134-08	9.394-09	8.064-09	5.754-09	5.068-09
10	4.749-08	3.646-08	2.943-08	2.321-08	1.791-08	1.342-08	1.184-08
11	9.839-08	6.739-08	4.861-08	3.672-08	2.468-08	1.809-08	1.417-08
12	7.474-08	5.600-08	4.138-08	3.135-08	2.387-08	1.612-08	1.245-08
13	8.323-09	6.066-09	4.636-09	3.545-09	2.489-09	1.930-09	1.520-09
14	2.975-09	2.183-09	1.651-09	1.272-09	9.377-10	7.158-10	5.937-10
15	0.	0.	0.	0.	0.	0.	0.

APPENDIX E

COMPUTER ANALYSIS CALCULATIONS AT CONSTANT ALTITUDE, WITH ALL SPECTRA COMPARED TO THE SPECTRUM AT 1.12 HOURS
(Computer Printout)

TABLE E-1

FRACTION OFF FIRST SPECTRA GHOST POINT,* ALTITUDE CONSTANT

ALTITUDE 1**

OUTPUT ENERGY GROUP	INPUT SPECTRA NUMBER 1	2	3	4	5	6	7	8	9	10	11
1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	0.	-0.011	-0.030	-0.055	-0.053	0.002	0.076	0.101	0.093	0.048	-0.031
3	0.	0.025	0.038	0.032	0.050	0.082	0.128	0.156	0.165	0.170	0.154
4	0.	-0.027	-0.049	-0.050	-0.032	0.080	0.203	0.171	0.138	0.200	0.156
5	0.	0.020	0.039	0.045	0.088	0.112	0.084	0.037	0.022	0.070	0.040
6	0.	0.007	0.142	0.215	0.201	0.348	0.458	0.177	-0.123	-0.238	-0.292
7	0.	-0.122	-0.246	-0.364	-0.401	-0.346	-0.419	-0.516	-0.504	-0.562	-0.649
8	0.	-0.023	-0.059	-0.133	-0.122	-0.171	-0.376	-0.452	-0.409	-0.424	-0.440
9	0.	0.218	0.381	0.405	0.549	0.245	-0.282	-0.283	-0.155	-0.089	0.012
10	0.	0.229	0.455	0.576	0.645	0.260	-0.260	-0.285	-0.158	0.013	0.403
11	0.	0.263	0.675	1.073	0.925	0.303	-0.206	-0.306	-0.184	0.296	1.536
12	0.	-0.108	-0.210	-0.112	-0.231	-0.434	-0.424	-0.230	-0.129	-0.145	-0.087
13	0.	-0.290	-0.644	-0.697	-0.806	-0.807	-0.564	-0.253	-0.169	-0.405	-0.881
14	0.	-0.313	-0.696	-0.817	-0.959	-0.970	-0.924	-0.861	-0.839	-0.878	-0.950
15	0.	-0.281	-0.563	-0.773	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000

*To find the Ghost Point for Output Energy Group 10 of Input Spectrum 7, multiply the flux value (App. C) of Output Energy Group 10 of Input Spectrum 1 by the quotient of the flux value of Output Energy Group 1 of Input Spectrum 7 divided by the flux value of Output Energy Group 1 of Input Spectrum 1.

**3 feet

TABLE E-2

FRACTION OFF FIRST SPECTRA GHOST POINT*, ALTITUDE CONSTANT

ALTITUDE 2**

OUTPUT ENERGY GROUP	INPUT SPECTRA NUMBER 1	2	3	4	5	6	7	8	9	10	11
1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	0.	-0.011	-0.028	-0.047	-0.045	0.006	0.070	0.085	0.075	0.042	-0.021
3	0.	0.002	-0.004	-0.019	-0.009	0.033	0.081	0.094	0.096	0.093	0.058
4	0.	-0.021	-0.032	-0.024	-0.018	0.040	0.107	0.082	0.060	0.105	0.087
5	0.	-0.014	-0.019	-0.020	-0.002	0.051	0.073	0.021	-0.009	0.024	-0.011
6	0.	-0.000	0.095	0.144	0.131	0.227	0.234	0.069	-0.153	-0.246	-0.280
7	0.	-0.111	-0.226	-0.325	-0.361	-0.338	-0.423	-0.494	-0.468	-0.514	-0.572
8	0.	-0.024	-0.068	-0.135	-0.124	-0.137	-0.384	-0.432	-0.376	-0.392	-0.412
9	0.	0.191	0.325	0.346	0.466	0.178	-0.304	-0.292	-0.161	-0.093	0.016
10	0.	0.214	0.416	0.522	0.584	0.219	-0.273	-0.286	-0.153	0.012	0.378
11	0.	0.230	0.582	0.929	0.792	0.226	-0.234	-0.305	-0.179	0.260	1.356
12	0.	-0.112	-0.223	-0.136	-0.250	-0.444	-0.433	-0.235	-0.128	-0.148	-0.108
13	0.	-0.294	-0.652	-0.709	-0.815	-0.814	-0.577	-0.266	-0.177	-0.416	-0.885
14	0.	-0.318	-0.702	-0.822	-0.960	-0.971	-0.925	-0.861	-0.838	-0.878	-0.952
15	0.	-0.286	-0.572	-0.780	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000

*See Table E-1

**10 feet

TABLE E-3

FRACTION OFF FIRST SPECTRA GHOST POINT*, ALTITUDE CONSTANT

ALTITUDE 3**

OUTPUT ENERGY GROUP	INPUT SPECTRA NUMBER 1	2	3	4	5	6	7	8	9	10	11
1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	0.	0.002	0.012	0.020	0.010	0.004	0.006	0.002	0.003	0.012	0.050
3	0.	0.003	0.012	0.016	0.026	0.025	0.025	0.034	0.043	0.056	0.050
4	0.	-0.010	-0.001	0.019	0.019	0.051	0.077	0.030	0.002	0.051	0.076
5	0.	-0.010	-0.001	0.012	0.011	0.015	-0.012	-0.073	-0.096	-0.060	-0.030
6	0.	-0.000	0.074	0.126	0.100	0.110	0.090	-0.064	-0.198	-0.239	-0.195
7	0.	-0.093	-0.195	-0.236	-0.314	-0.315	-0.424	-0.480	-0.444	-0.483	-0.540
8	0.	0.012	0.016	-0.009	-0.006	-0.131	-0.372	-0.419	-0.351	-0.319	-0.224
9	0.	0.167	0.285	0.315	0.413	0.122	-0.325	-0.302	-0.172	-0.101	0.026
10	0.	0.186	0.363	0.487	0.522	0.155	-0.295	-0.292	-0.161	0.006	0.398
11	0.	0.212	0.546	0.892	0.747	0.186	-0.254	-0.313	-0.186	0.240	1.350
12	0.	-0.117	-0.234	-0.148	-0.267	-0.461	-0.449	-0.255	-0.148	-0.162	-0.109
13	0.	-0.292	-0.649	-0.705	-0.814	-0.815	-0.583	-0.280	-0.189	-0.416	-0.882
14	0.	-0.316	-0.599	-0.320	-0.959	-0.971	-0.926	-0.363	-0.839	-0.877	-0.950
15	0.	-0.234	-0.563	-0.776	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000

*See Table E-1

**25 feet

TABLF E-4

FRACTION OFF FIRST SPECTRA GHOST POINT*,ALTITUDE CONSTANT

ALTITUDE 4**

OUTPUT ENERGY GROUP	INPUT SPECTRA NUMBER 1	2	3	4	5	6	7	8	9	10	11
1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	0.	-0.006	-0.014	-0.023	-0.022	-0.008	0.001	-0.002	-0.002	-0.008	-0.027
3	0.	-0.005	-0.010	-0.007	-0.001	0.007	0.019	0.024	0.021	0.020	-0.010
4	0.	-0.007	0.005	0.023	0.023	0.043	0.048	-0.004	-0.035	0.004	0.031
5	0.	-0.001	0.015	0.027	0.030	0.016	-0.038	-0.099	-0.122	-0.100	-0.075
6	0.	0.003	0.057	0.095	0.081	0.062	0.006	-0.107	-0.202	-0.245	-0.226
7	0.	-0.081	-0.174	-0.249	-0.279	-0.307	-0.422	-0.462	-0.419	-0.451	-0.485
8	0.	0.026	0.036	0.013	0.029	-0.113	-0.370	-0.402	-0.327	-0.300	-0.222
9	0.	0.157	0.267	0.303	0.393	0.097	-0.331	-0.294	-0.163	-0.097	0.029
10	0.	0.160	0.316	0.430	0.459	0.100	-0.309	-0.281	-0.150	-0.007	0.338
11	0.	0.164	0.429	0.731	0.599	0.086	-0.290	-0.307	-0.183	0.170	1.099
12	0.	-0.124	-0.258	-0.184	-0.299	-0.432	-0.453	-0.244	-0.134	-0.172	-0.173
13	0.	-0.285	-0.643	-0.700	-0.809	-0.811	-0.578	-0.267	-0.174	-0.407	-0.881
14	0.	-0.309	-0.694	-0.817	-0.958	-0.970	-0.925	-0.961	-0.837	-0.876	-0.950
15	0.	-0.277	-0.560	-0.773	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000

* See Table E-1

** 50 feet

TABLE E-5

FRACTION OFF FIRST SPECTRA GHOST POINT*, ALTITUDE CONSTANT

ALTITUDE 5 **

OUTPUT ENERGY GROUP	INPUT SPECTRA NUMBER 1	2	3	4	5	6	7	8	9	10	11
1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	0.	-0.007	-0.013	-0.008	-0.010	-0.005	0.015	0.029	0.028	0.019	-0.003
3	0.	-0.011	-0.015	-0.011	-0.014	-0.007	-0.001	-0.015	-0.028	-0.030	-0.039
4	0.	0.004	0.024	0.056	0.047	0.016	-0.013	-0.039	-0.048	-0.015	0.042
5	0.	0.005	0.036	0.069	0.055	0.011	-0.047	-0.101	-0.126	-0.109	-0.039
6	0.	-0.005	0.033	0.069	0.042	-0.001	-0.059	-0.140	-0.204	-0.237	-0.190
7	0.	-0.040	-0.089	-0.125	-0.151	-0.234	-0.389	-0.412	-0.353	-0.357	-0.318
8	0.	0.021	0.034	0.048	0.034	-0.137	-0.369	-0.374	-0.291	-0.246	-0.101
9	0.	0.144	0.250	0.301	0.364	0.075	-0.320	-0.275	-0.144	-0.075	0.082
10	0.	0.154	0.312	0.441	0.444	0.038	-0.301	-0.275	-0.145	0.013	0.409
11	0.	0.142	0.377	0.665	0.523	0.047	-0.287	-0.285	-0.161	0.168	1.038
12	0.	-0.120	-0.244	-0.161	-0.281	-0.467	-0.439	-0.224	-0.114	-0.150	-0.124
13	0.	-0.292	-0.650	-0.708	-0.817	-0.817	-0.578	-0.256	-0.164	-0.411	-0.883
14	0.	-0.315	-0.699	-0.820	-0.959	-0.970	-0.924	-0.856	-0.832	-0.874	-0.950
15	0.	-0.283	-0.568	-0.777	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000

*See Table E-1

**100 feet

TABLE E-6

FRACTION OFF FIRST SPECTRA GHOST POINT*, ALTITUDE CONSTANT

ALTITUDE 6 **

OUTPUT ENERGY GROUP	INPUT SPECTRA NUMBER 1	2	3	4	5	6	7	8	9	10	11
1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	0.	0.007	0.017	0.030	0.030	0.016	0.007	0.008	0.007	0.012	0.023
3	0.	-0.010	-0.022	-0.023	-0.022	-0.025	-0.030	-0.027	-0.024	-0.026	-0.046
4	0.	0.001	0.006	0.024	0.024	-0.010	-0.048	-0.053	-0.053	-0.043	-0.032
5	0.	0.005	0.012	0.024	0.025	-0.036	-0.123	-0.138	-0.133	-0.144	-0.135
6	0.	-0.008	0.001	0.029	0.006	-0.070	-0.150	-0.173	-0.139	-0.220	-0.189
7	0.	-0.023	-0.054	-0.067	-0.096	-0.215	-0.384	-0.392	-0.320	-0.301	-0.207
8	0.	0.030	0.036	0.034	0.042	-0.123	-0.360	-0.345	-0.252	-0.229	-0.147
9	0.	0.105	0.161	0.194	0.246	-0.013	-0.348	-0.273	-0.141	-0.101	-0.009
10	0.	0.123	0.236	0.343	0.345	0.021	-0.316	-0.256	-0.121	-0.000	0.303
11	0.	0.116	0.306	0.559	0.431	-0.007	-0.302	-0.270	-0.141	0.145	0.888
12	0.	-0.141	-0.299	-0.241	-0.353	-0.512	-0.455	-0.216	-0.102	-0.174	-0.232
13	0.	-0.292	-0.653	-0.713	-0.820	-0.819	-0.531	-0.251	-0.154	-0.409	-0.886
14	0.	-0.315	-0.701	-0.822	-0.960	-0.971	-0.924	-0.854	-0.829	-0.873	-0.951
15	0.	-0.283	-0.571	-0.780	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000

*See Table E-1

**150 feet

TABLE E-7

FRACTION OFF FIRST SPECTRA GHOST POINT*, ALTITUDE CONSTANT

ALTITUDE 7**

OUTPUT ENERGY GROUP	INPUT SPECTRA NUMBER 1	2	3	4	5	6	7	8	9	10	11
1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	0.	0.007	0.009	0.005	0.015	0.009	-0.010	-0.010	-0.006	-0.003	-0.009
3	0.	0.023	0.042	0.042	0.065	0.048	-0.002	-0.017	-0.016	-0.009	-0.012
4	0.	0.024	0.057	0.080	0.085	0.033	-0.042	-0.070	-0.069	-0.040	0.026
5	0.	0.035	0.097	0.117	0.121	0.043	-0.071	-0.114	-0.120	-0.100	-0.012
6	0.	0.012	0.037	0.063	0.051	-0.039	-0.150	-0.175	-0.176	-0.183	-0.129
7	0.	0.010	-0.000	-0.020	-0.021	-0.151	-0.357	-0.357	-0.276	-0.257	-0.183
8	0.	0.049	0.072	0.074	0.092	-0.088	-0.346	-0.328	-0.231	-0.192	-0.083
9	0.	0.148	0.259	0.312	0.382	0.086	-0.299	-0.237	-0.097	-0.018	0.155
10	0.	0.142	0.287	0.410	0.417	0.068	-0.290	-0.237	-0.100	0.054	0.434
11	0.	0.156	0.398	0.568	0.556	0.078	-0.271	-0.264	-0.132	0.204	1.064
12	0.	-0.131	-0.291	-0.240	-0.346	-0.502	-0.436	-0.186	-0.069	-0.147	-0.232
13	0.	-0.276	-0.638	-0.703	-0.812	-0.811	-0.570	-0.241	-0.142	-0.393	-0.880
14	0.	-0.299	-0.687	-0.815	-0.957	-0.969	-0.920	-0.850	-0.823	-0.868	-0.948
15	0.	-0.266	-0.551	-0.770	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000

*See Table E-1

**200 feet

APPENDIX F

COMPUTER ANALYSIS CALCULATIONS AT CONSTANT ALTITUDE, WITH EACH SPECTRUM COMPARED TO THE SPECTRUM AT THE PREVIOUS DECAY TIME (Computer Printout)

TABLE F-1

FRACTIONAL CHANGE POINT BY POINT FROM SPECTRA T-1 TO T

ALTITUDE 1*

OUTPUT ENERGY GROUP	INPUT SPECTRA NUMBER 1	2	3	4	5	6	7	8	9	10	11
1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	0.	-0.011	-0.019	-0.026	0.003	0.058	0.074	0.024	-0.007	-0.042	-0.075
3	0.	0.025	0.013	-0.006	0.018	0.030	0.043	0.025	0.008	0.004	-0.013
4	0.	-0.027	-0.023	-0.001	0.019	0.117	0.113	-0.026	-0.029	0.055	-0.037
5	0.	0.020	0.019	0.005	0.041	0.023	-0.026	-0.043	-0.014	0.046	-0.028
6	0.	0.007	0.134	0.064	-0.012	0.123	0.081	-0.192	-0.255	-0.132	-0.071
7	0.	-0.122	-0.141	-0.157	-0.059	0.092	-0.112	-0.166	0.024	-0.116	-0.200
8	0.	-0.023	-0.037	-0.079	0.013	-0.056	-0.247	-0.122	0.079	-0.026	-0.027
9	0.	0.218	0.134	0.017	0.103	-0.196	-0.423	-0.002	0.178	0.079	0.111
10	0.	0.229	0.184	0.083	0.044	-0.234	-0.413	-0.033	0.177	0.203	0.385
11	0.	0.263	0.326	0.237	-0.071	-0.323	-0.391	-0.125	0.175	0.588	0.957
12	0.	-0.103	-0.115	0.124	-0.134	-0.263	0.018	0.336	0.131	-0.018	0.067
13	0.	-0.290	-0.499	-0.150	-0.360	-0.003	1.254	0.715	0.113	-0.284	-0.800
14	0.	-0.313	-0.557	-0.398	-0.774	-0.277	1.531	0.835	0.156	-0.241	-0.592
15	0.	-0.281	-0.392	-0.480	-1.000	0.	0.	0.	0.	0.	0.

*3 feet

TABLE F-2

FRACTIONAL CHANGE POINT BY POINT FROM SPECTRA I-1 TO I

ALTITUDE 2*

OUTPUT ENERGY GROUP	INPUT SPECTRA NUMBER 1	2	3	4	5	6	7	8	9	10	11
1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	0.	-0.011	-0.016	-0.020	0.003	0.053	0.054	0.014	-0.009	-0.031	-0.061
3	0.	0.002	-0.006	-0.015	0.010	0.042	0.046	0.012	0.002	-0.003	-0.032
4	0.	-0.021	-0.012	0.008	0.006	0.060	0.064	-0.023	-0.020	0.042	-0.016
5	0.	-0.014	-0.005	-0.001	0.018	0.053	0.021	-0.048	-0.029	0.033	-0.035
6	0.	-0.000	0.096	0.045	-0.011	0.085	0.046	-0.167	-0.208	-0.109	-0.046
7	0.	-0.111	-0.129	-0.128	-0.054	0.035	-0.128	-0.124	0.051	-0.085	-0.121
8	0.	-0.024	-0.045	-0.072	0.012	-0.072	-0.243	-0.077	0.099	-0.027	-0.033
9	0.	0.191	0.112	0.016	0.089	-0.196	-0.409	0.017	0.185	0.081	0.120
10	0.	0.214	0.167	0.075	0.041	-0.230	-0.404	-0.017	0.185	0.196	0.361
11	0.	0.230	0.287	0.219	-0.071	-0.316	-0.375	-0.093	0.182	0.533	0.871
12	0.	-0.112	-0.125	0.112	-0.132	-0.258	0.020	0.348	0.140	-0.023	0.047
13	0.	-0.294	-0.507	-0.164	-0.363	0.004	1.270	0.735	0.122	-0.290	-0.804
14	0.	-0.318	-0.563	-0.405	-0.773	-0.271	1.547	0.856	0.166	-0.248	-0.603
15	0.	-0.286	-0.400	-0.486	-1.000	0.	0.	0.	0.	0.	0.

*10 feet

TABLE F-3

FRACTIONAL CHANGE POINT BY POINT FROM SPECTRA T-1 TO T

ALTITUDE 3*

OUTPUT ENERGY GROUP	INPUT SPECTRA NUMBER 1	2	3	4	5	6	7	8	9	10	11
1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	0.	0.002	0.010	0.008	-0.010	-0.006	0.003	-0.004	0.001	0.009	0.037
3	0.	0.008	0.004	0.004	0.009	-0.001	-0.000	0.008	0.009	0.013	-0.006
4	0.	-0.010	0.009	0.020	0.001	0.031	0.025	-0.044	-0.027	0.049	0.024
5	0.	-0.010	0.009	0.013	-0.000	0.005	-0.027	-0.062	-0.024	0.040	0.031
6	0.	0.000	0.074	0.049	-0.024	0.009	-0.018	-0.141	-0.144	-0.051	0.058
7	0.	-0.093	-0.113	-0.112	-0.040	-0.003	-0.157	-0.098	0.070	-0.071	-0.110
8	0.	0.012	0.003	-0.024	0.003	-0.126	-0.277	-0.075	0.117	0.050	0.139
9	0.	0.167	0.101	0.024	0.074	-0.206	-0.399	0.034	0.186	0.086	0.141
10	0.	0.186	0.154	0.087	0.024	-0.241	-0.339	0.004	0.185	0.199	0.390
11	0.	0.212	0.276	0.223	-0.077	-0.321	-0.371	-0.079	0.184	0.524	0.895
12	0.	-0.117	-0.133	0.112	-0.140	-0.264	0.023	0.351	0.144	-0.016	0.062
13	0.	-0.292	-0.504	-0.161	-0.368	-0.006	1.252	0.729	0.126	-0.280	-0.798
14	0.	-0.316	-0.560	-0.401	-0.775	-0.278	1.526	0.349	0.170	-0.237	-0.591
15	0.	-0.284	-0.396	-0.483	-1.000	0.	0.	0.	0.	0.	0.

*25 feet

TABLE F-4

FRACTIONAL CHANGE POINT BY POINT FROM SPECTRA T-1 TO T

ALTITUDE 4*

OUTPUT ENERGY GROUP	INPUT SPECTRA NUMBER 1	2	3	4	5	6	7	8	9	10	11
1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	0.	-0.006	-0.008	-0.009	0.002	0.014	0.008	-0.002	-0.001	-0.006	-0.020
3	0.	-0.005	-0.006	0.003	0.006	0.008	0.012	0.005	-0.003	-0.002	-0.029
4	0.	-0.007	0.012	0.018	0.000	0.020	0.005	-0.050	-0.030	0.040	0.027
5	0.	-0.001	0.016	0.012	0.003	-0.013	-0.054	-0.063	-0.025	0.025	0.029
6	0.	0.003	0.054	0.036	-0.013	-0.017	-0.053	-0.112	-0.106	-0.054	0.025
7	0.	-0.081	-0.101	-0.090	-0.040	-0.038	-0.167	-0.069	0.081	-0.055	-0.063
8	0.	0.026	0.009	-0.022	0.015	-0.138	-0.290	-0.050	0.126	0.040	0.112
9	0.	0.157	0.095	0.029	0.069	-0.213	-0.390	0.055	0.195	0.079	0.139
10	0.	0.160	0.134	0.037	0.020	-0.246	-0.372	0.040	0.132	0.168	0.348
11	0.	0.164	0.228	0.211	-0.076	-0.321	-0.346	-0.024	0.179	0.432	0.794
12	0.	-0.124	-0.153	0.101	-0.141	-0.251	0.055	0.383	0.144	-0.043	-0.001
13	0.	-0.285	-0.500	-0.160	-0.362	-0.011	1.231	0.735	0.128	-0.282	-0.799
14	0.	-0.309	-0.557	-0.401	-0.773	-0.281	1.503	0.856	0.172	-0.239	-0.593
15	0.	-0.277	-0.392	-0.483	-1.000	0.	0.	0.	0.	0.	0.

*50 feet

TABLE F-5

FRACTIONAL CHANGE POINT BY POINT FROM SPECTRA T-1 TO T

ALTITUDE 5*

OUTPUT ENERGY GROUP	INPUT SPECTRA NUMBER 1	2	3	4	5	6	7	8	9	10	11
1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	0.	-0.007	-0.006	0.005	-0.002	0.004	0.020	0.014	-0.001	-0.009	-0.022
3	0.	-0.011	-0.004	0.003	-0.003	0.007	0.006	-0.014	-0.013	-0.002	-0.010
4	0.	0.004	0.020	0.031	-0.008	-0.030	-0.029	-0.026	-0.010	0.035	0.058
5	0.	0.005	0.031	0.032	-0.014	-0.041	-0.058	-0.056	-0.029	0.020	0.079
6	0.	-0.005	0.038	0.035	-0.026	-0.040	-0.058	-0.086	-0.074	-0.042	0.061
7	0.	-0.040	-0.050	-0.039	-0.030	-0.099	-0.202	-0.037	0.101	-0.007	0.061
8	0.	0.021	0.013	0.014	-0.014	-0.165	-0.269	-0.007	0.132	0.064	0.192
9	0.	0.144	0.092	0.041	0.049	-0.212	-0.367	0.066	0.181	0.081	0.169
10	0.	0.154	0.137	0.098	0.002	-0.246	-0.358	0.037	0.180	0.185	0.391
11	0.	0.142	0.206	0.209	-0.085	-0.313	-0.318	0.002	0.174	0.392	0.745
12	0.	-0.120	-0.140	0.109	-0.143	-0.259	0.053	0.382	0.141	-0.040	0.030
13	0.	-0.292	-0.506	-0.165	-0.373	-0.002	1.307	0.764	0.124	-0.295	-0.802
14	0.	-0.315	-0.561	-0.401	-0.775	-0.274	1.538	0.887	0.167	-0.253	-0.600
15	0.	-0.283	-0.397	-0.483	-1.000	0.	0.	0.	0.	0.	0.

*100 feet

TABLE F-6

FRACTIONAL CHANGE POINT BY POINT FROM SPECTRA I-1 TO I

ALTITUDE 6*

OUTPUT ENERGY GROUP	INPUT SPECTRA NUMBER 1	2	3	4	5	6	7	8	9	10	11
1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	0.	0.007	0.010	0.013	0.001	-0.014	-0.009	0.001	-0.002	0.006	0.011
3	0.	-0.010	-0.012	-0.001	0.001	-0.003	-0.005	0.003	0.003	-0.002	-0.021
4	0.	0.001	0.005	0.019	-0.000	-0.034	-0.038	-0.006	0.000	0.010	0.012
5	0.	0.005	0.008	0.011	0.001	-0.059	-0.090	-0.017	0.005	-0.012	0.011
6	0.	-0.008	0.010	0.027	-0.022	-0.075	-0.037	-0.027	-0.019	-0.038	0.040
7	0.	-0.023	-0.032	-0.013	-0.032	-0.132	-0.216	-0.012	0.118	0.028	0.133
8	0.	0.030	0.006	-0.002	0.007	-0.158	-0.271	0.025	0.142	0.031	0.106
9	0.	0.105	0.051	0.029	0.043	-0.208	-0.340	0.115	0.182	0.046	0.102
10	0.	0.123	0.101	0.086	0.002	-0.241	-0.330	0.087	0.181	0.138	0.304
11	0.	0.116	0.170	0.193	-0.082	-0.306	-0.296	0.045	0.177	0.334	0.649
12	0.	-0.141	-0.183	0.083	-0.148	-0.246	0.116	0.438	0.145	-0.080	-0.070
13	0.	-0.292	-0.510	-0.173	-0.371	0.003	1.316	0.787	0.130	-0.302	-0.806
14	0.	-0.315	-0.564	-0.406	-0.773	-0.270	1.597	0.911	0.174	-0.260	-0.611
15	0.	-0.283	-0.402	-0.487	-1.000	0.	0.	0.	0.	0.	0.

*150 feet

TABLE F-7

FRACTIONAL CHANGE POINT BY POINT FROM SPECTRA T-1 TO T

ALTITUDE 7*

OUTPUT ENERGY GROUP	INPUT SPECTRA NUMBER 1	2	3	4	5	6	7	8	9	10	11
1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	0.	0.007	0.002	-0.003	0.009	-0.006	-0.018	0.	0.	0.	0.
3	0.	0.023	0.019	0.001	0.021	-0.016	-0.048	-0.000	0.004	0.003	-0.006
4	0.	0.024	0.032	0.022	0.004	-0.048	-0.073	-0.015	0.001	0.008	-0.004
5	0.	0.035	0.050	0.028	0.004	-0.070	-0.109	-0.029	0.001	0.032	0.069
6	0.	0.012	0.025	0.024	-0.011	-0.086	-0.115	-0.046	-0.007	0.023	0.098
7	0.	0.010	-0.010	-0.020	-0.001	-0.133	-0.243	-0.029	-0.001	-0.015	0.073
8	0.	0.049	0.022	0.002	0.017	-0.165	-0.283	0.000	0.126	0.025	0.101
9	0.	0.148	0.097	0.043	0.053	-0.214	-0.354	0.026	0.146	0.050	0.135
10	0.	0.142	0.127	0.096	0.005	-0.247	-0.335	0.089	0.183	0.087	0.176
11	0.	0.156	0.209	0.193	-0.067	-0.307	-0.324	0.075	0.180	0.171	0.360
12	0.	-0.131	-0.184	0.073	-0.140	-0.238	0.132	0.009	0.180	0.387	0.714
13	0.	-0.276	-0.500	-0.179	-0.367	0.004	1.277	0.442	0.145	-0.084	-0.099
14	0.	-0.299	-0.554	-0.407	-0.770	-0.268	1.552	0.767	0.131	-0.292	-0.803
15	0.	-0.266	-0.389	-0.486	-1.000	0.	0.	0.889	0.174	-0.250	-0.605

*200 feet

APPENDIX G

COMPUTER ANALYSIS CALCULATIONS AT CONSTANT DECAY TIMES, WITH ALL SPECTRA COMPARED TO THE SPECTRUM AT 3 FEET

(Computer Printout)

TABLE G- 1

FRACTION OFF 3 FOOT ALTITUDE GHOST POINT, INPUT SPECTRA CONSTANT-SPECTRA 1

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	0.	0.	0.	0.	0.	0.	0.
2	0.	-0.114	0.000	-0.193	-0.253	-0.271	-0.363
3	0.	-0.123	-0.011	-0.237	-0.275	-0.382	-0.435
4	0.	-0.132	-0.137	-0.293	-0.396	-0.437	-0.533
5	0.	-0.289	-0.305	-0.445	-0.568	-0.603	-0.690
6	0.	-0.110	-0.196	-0.368	-0.526	-0.577	-0.650
7	0.	-0.271	-0.396	-0.576	-0.674	-0.731	-0.780
8	0.	-0.278	-0.381	-0.566	-0.681	-0.759	-0.810
9	0.	-0.270	-0.449	-0.600	-0.701	-0.775	-0.830
10	0.	-0.306	-0.425	-0.583	-0.720	-0.781	-0.824
11	0.	-0.345	-0.507	-0.533	-0.768	-0.822	-0.873
12	0.	-0.319	-0.475	-0.624	-0.752	-0.815	-0.857
13	0.	-0.327	-0.480	-0.653	-0.773	-0.826	-0.869
14	0.	-0.330	-0.491	-0.657	-0.768	-0.825	-0.863
15	0.	-0.318	-0.478	-0.642	-0.759	-0.812	-0.851

TABLE G- 2

FRACTION OFF 3 FOOT ALTITUDE GHOST POINT, INPUT SPECTRA CONSTANT-SPECTRA 2

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	0.	0.	0.	0.	0.	0.	0.
2	0.	-0.114	0.014	-0.199	-0.250	-0.258	-0.351
3	0.	-0.142	-0.027	-0.259	-0.300	-0.404	-0.436
4	0.	-0.127	-0.122	-0.279	-0.377	-0.421	-0.509
5	0.	-0.312	-0.325	-0.457	-0.574	-0.609	-0.685
6	0.	-0.117	-0.202	-0.370	-0.531	-0.583	-0.648
7	0.	-0.262	-0.377	-0.556	-0.644	-0.700	-0.747
8	0.	-0.279	-0.359	-0.544	-0.667	-0.746	-0.796
9	0.	-0.286	-0.472	-0.620	-0.719	-0.796	-0.840
10	0.	-0.315	-0.445	-0.607	-0.738	-0.800	-0.837
11	0.	-0.363	-0.527	-0.662	-0.790	-0.843	-0.883
12	0.	-0.323	-0.481	-0.631	-0.756	-0.822	-0.861
13	0.	-0.331	-0.482	-0.651	-0.774	-0.827	-0.867
14	0.	-0.334	-0.492	-0.655	-0.763	-0.825	-0.860
15	0.	-0.322	-0.480	-0.640	-0.759	-0.812	-0.848

TABLE G- 3

FRACTION OFF 3 FOOT ALTITUDE GHOST POINT, INPUT SPECTRA CONSTANT-SPECTRA 3

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	0.	0.	0.	0.	0.	0.	0.
2	0.	-0.112	0.044	-0.180	-0.240	-0.235	-0.337
3	0.	-0.158	-0.036	-0.273	-0.312	-0.419	-0.434
4	0.	-0.117	-0.094	-0.253	-0.350	-0.405	-0.482
5	0.	-0.329	-0.332	-0.459	-0.569	-0.613	-0.676
6	0.	-0.146	-0.244	-0.415	-0.571	-0.629	-0.682
7	0.	-0.252	-0.357	-0.535	-0.607	-0.662	-0.708
8	0.	-0.285	-0.332	-0.522	-0.650	-0.735	-0.783
9	0.	-0.299	-0.488	-0.633	-0.729	-0.811	-0.845
10	0.	-0.325	-0.459	-0.623	-0.748	-0.814	-0.845
11	0.	-0.382	-0.545	-0.687	-0.809	-0.861	-0.894
12	0.	-0.330	-0.491	-0.647	-0.763	-0.836	-0.872
13	0.	-0.342	-0.488	-0.652	-0.777	-0.830	-0.867
14	0.	-0.343	-0.496	-0.655	-0.770	-0.828	-0.859
15	0.	-0.331	-0.483	-0.640	-0.761	-0.815	-0.847

TABLE G- 4

FRACTION OFF 3 FOOT ALTITUDE GHOST POINT, INPUT SPECTRA CONSTANT-SPECTRA 4

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	0.	0.	0.	0.	0.	0.	0.
2	0.	-0.106	0.081	-0.166	-0.216	-0.205	-0.322
3	0.	-0.166	-0.026	-0.266	-0.305	-0.415	-0.430
4	0.	-0.109	-0.075	-0.239	-0.329	-0.393	-0.469
5	0.	-0.333	-0.327	-0.455	-0.557	-0.611	-0.668
6	0.	-0.162	-0.255	-0.430	-0.583	-0.642	-0.694
7	0.	-0.227	-0.322	-0.499	-0.552	-0.605	-0.661
8	0.	-0.280	-0.292	-0.493	-0.614	-0.712	-0.764
9	0.	-0.300	-0.464	-0.629	-0.723	-0.809	-0.841
10	0.	-0.330	-0.457	-0.622	-0.744	-0.813	-0.843
11	0.	-0.391	-0.550	-0.694	-0.813	-0.866	-0.898
12	0.	-0.338	-0.497	-0.654	-0.766	-0.842	-0.878
13	0.	-0.353	-0.494	-0.656	-0.781	-0.835	-0.872
14	0.	-0.351	-0.498	-0.657	-0.771	-0.830	-0.862
15	0.	-0.339	-0.486	-0.642	-0.763	-0.818	-0.849

TABLE G- 5

FRACTION OFF 3 FOOT ALTITUDE GHOST POINT, INPUT SPECTRA CONSTANT-SPECTRA 5

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	0.	0.	0.	0.	0.	0.	0.
2	0.	-0.106	0.067	-0.167	-0.219	-0.207	-0.317
3	0.	-0.172	-0.034	-0.275	-0.320	-0.425	-0.428
4	0.	-0.120	-0.091	-0.253	-0.347	-0.404	-0.477
5	0.	-0.348	-0.354	-0.475	-0.581	-0.626	-0.680
6	0.	-0.162	-0.264	-0.431	-0.589	-0.646	-0.693
7	0.	-0.222	-0.309	-0.489	-0.538	-0.593	-0.640
8	0.	-0.280	-0.299	-0.492	-0.625	-0.714	-0.763
9	0.	-0.309	-0.498	-0.640	-0.737	-0.819	-0.848
10	0.	-0.332	-0.468	-0.630	-0.755	-0.821	-0.849
11	0.	-0.390	-0.552	-0.695	-0.816	-0.868	-0.897
12	0.	-0.336	-0.500	-0.657	-0.768	-0.845	-0.879
13	0.	-0.356	-0.501	-0.658	-0.786	-0.838	-0.873
14	0.	-0.349	-0.500	-0.655	-0.772	-0.830	-0.859
15	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000

TABLE G- 6

FRACTION OFF 3 FOOT ALTITUDE GHOST POINT, INPUT SPECTRA CONSTANT-SPECTRA 6

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	0.	0.	0.	0.	0.	0.	0.
2	0.	-0.111	0.002	-0.201	-0.258	-0.260	-0.358
3	0.	-0.162	-0.063	-0.290	-0.334	-0.444	-0.453
4	0.	-0.164	-0.161	-0.317	-0.432	-0.484	-0.554
5	0.	-0.328	-0.365	-0.493	-0.607	-0.655	-0.709
6	0.	-0.190	-0.339	-0.502	-0.648	-0.708	-0.750
7	0.	-0.263	-0.369	-0.550	-0.619	-0.677	-0.714
8	0.	-0.292	-0.351	-0.536	-0.668	-0.745	-0.791
9	0.	-0.309	-0.504	-0.643	-0.742	-0.822	-0.852
10	0.	-0.329	-0.473	-0.636	-0.759	-0.823	-0.851
11	0.	-0.384	-0.551	-0.694	-0.813	-0.865	-0.895
12	0.	-0.331	-0.500	-0.655	-0.767	-0.841	-0.875
13	0.	-0.351	-0.502	-0.651	-0.785	-0.837	-0.872
14	0.	-0.343	-0.500	-0.657	-0.771	-0.828	-0.858
15	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000

TABLE G- 7

FRACTION OFF 3 FOOT ALTITUDE GHOST POINT, INPUT SPECTRA CONSTANT-SPECTRA 7

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	0.	0.	0.	0.	0.	0.	0.
2	0.	-0.119	-0.064	-0.250	-0.295	-0.317	-0.413
3	0.	-0.160	-0.101	-0.311	-0.358	-0.469	-0.501
4	0.	-0.201	-0.227	-0.384	-0.505	-0.554	-0.628
5	0.	-0.296	-0.366	-0.508	-0.620	-0.678	-0.734
6	0.	-0.217	-0.399	-0.564	-0.694	0.753	-0.796
7	0.	-0.276	-0.401	-0.578	-0.658	-0.715	-0.756
8	0.	-0.288	-0.377	-0.562	-0.678	-0.753	-0.801
9	0.	-0.292	-0.493	-0.627	-0.717	-0.796	-0.834
10	0.	-0.318	-0.451	-0.611	-0.736	-0.798	-0.832
11	0.	-0.368	-0.536	-0.672	-0.791	-0.844	-0.883
12	0.	-0.330	-0.493	-0.643	-0.759	-0.825	-0.860
13	0.	-0.347	-0.503	-0.664	-0.780	-0.833	-0.871
14	0.	-0.339	-0.501	-0.661	-0.766	-0.824	-0.856
15	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000

TABLE G- 8

FRACTION OFF 3 FOOT ALTITUDE GHOST POINT, INPUT SPECTRA CONSTANT-SPECTRA 8

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	0.	0.	0.	0.	0.	0.	0.
2	0.	-0.127	-0.090	-0.269	-0.303	-0.332	-0.427
3	0.	-0.170	-0.116	-0.324	-0.382	-0.430	-0.520
4	0.	-0.193	-0.241	-0.399	-0.505	-0.545	-0.629
5	0.	-0.300	-0.379	-0.519	-0.625	-0.670	-0.735
6	0.	-0.192	-0.361	-0.521	-0.653	-0.703	-0.754
7	0.	-0.239	-0.351	-0.529	-0.605	-0.662	-0.708
8	0.	-0.251	-0.343	-0.526	-0.635	-0.711	-0.767
9	0.	-0.279	-0.464	-0.606	-0.698	-0.772	-0.819
10	0.	-0.307	-0.430	-0.581	-0.717	-0.772	-0.813
11	0.	-0.345	-0.512	-0.634	-0.761	-0.813	-0.865
12	0.	-0.324	-0.492	-0.630	-0.750	-0.812	-0.849
13	0.	-0.339	-0.499	-0.660	-0.774	-0.826	-0.867
14	0.	-0.332	-0.497	-0.657	-0.759	-0.817	-0.852
15	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000

TABLE G- 9

FRACTION OFF 3 FOOT ALTITUDE GHOST POINT, INPUT SPECTRA CONSTANT-SPECTRA 9

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	0.	0.	0.	0.	0.	0.	0.
2	0.	-0.129	-0.082	-0.264	-0.298	-0.329	-0.420
3	0.	-0.174	-0.115	-0.331	-0.395	-0.483	-0.523
4	0.	-0.191	-0.240	-0.400	-0.495	-0.532	-0.618
5	0.	-0.311	-0.385	-0.524	-0.631	-0.663	-0.733
6	0.	-0.142	-0.266	-0.425	-0.569	-0.609	-0.671
7	0.	-0.219	-0.322	-0.502	-0.575	-0.630	-0.678
8	0.	-0.238	-0.320	-0.506	-0.617	-0.695	-0.753
9	0.	-0.274	-0.460	-0.603	-0.697	-0.771	-0.818
10	0.	-0.302	-0.426	-0.579	-0.716	-0.772	-0.812
11	0.	-0.341	-0.508	-0.633	-0.761	-0.813	-0.865
12	0.	-0.318	-0.486	-0.626	-0.748	-0.810	-0.848
13	0.	-0.334	-0.493	-0.656	-0.772	-0.823	-0.865
14	0.	-0.326	-0.491	-0.652	-0.757	-0.814	-0.850
15	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000

TABLE G-10

FRACTION OFF 3 FOOT ALTITUDE GHOST POINT, INPUT SPECTRA CONSTANT-SPECTRA 10

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	0.	0.	0.	0.	0.	0.	0.
2	0.	-0.119	-0.033	-0.236	-0.273	-0.295	-0.393
3	0.	-0.181	-0.107	-0.335	-0.399	-0.486	-0.522
4	0.	-0.201	-0.244	-0.408	-0.505	-0.551	-0.627
5	0.	-0.319	-0.389	-0.534	-0.640	-0.632	-0.739
6	0.	-0.119	-0.198	-0.374	-0.525	-0.567	-0.627
7	0.	-0.191	-0.288	-0.468	-0.522	-0.570	-0.627
8	0.	-0.238	-0.268	-0.473	-0.582	-0.677	-0.733
9	0.	-0.273	-0.457	-0.603	-0.696	-0.778	-0.817
10	0.	-0.306	-0.428	-0.591	-0.720	-0.784	-0.817
11	0.	-0.364	-0.528	-0.669	-0.791	-0.843	-0.882
12	0.	-0.322	-0.485	-0.635	-0.754	-0.822	-0.858
13	0.	-0.339	-0.490	-0.655	-0.775	-0.827	-0.866
14	0.	-0.332	-0.489	-0.652	-0.761	-0.819	-0.852
15	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000

TABLE G-11

FRACTION OFF 3 FOOT ALTITUDE GHOST POINT, INPUT SPECTRA CONSTANT-SPECTRA 11

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	0.	0.	0.	0.	0.	0.	0.
2	0.	-0.106	0.083	-0.191	-0.232	-0.231	-0.348
3	0.	-0.196	-0.100	-0.346	-0.396	-0.490	-0.517
4	0.	-0.134	-0.197	-0.369	-0.456	-0.529	-0.586
5	0.	-0.324	-0.352	-0.507	-0.600	-0.670	-0.705
6	0.	-0.095	-0.086	-0.309	-0.457	-0.515	-0.569
7	0.	-0.111	-0.208	-0.376	-0.367	-0.391	-0.487
8	0.	-0.243	-0.143	-0.397	-0.488	-0.633	-0.689
9	0.	-0.267	-0.442	-0.593	-0.681	-0.780	-0.806
10	0.	-0.318	-0.427	-0.602	-0.719	-0.797	-0.821
11	0.	-0.392	-0.543	-0.696	-0.813	-0.868	-0.896
12	0.	-0.335	-0.488	-0.659	-0.762	-0.845	-0.880
13	0.	-0.353	-0.485	-0.653	-0.777	-0.833	-0.868
14	0.	-0.349	-0.487	-0.652	-0.765	-0.827	-0.856
15	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000

APPENDIX H

COMPUTER ANALYSIS CALCULATIONS AT CONSTANT DECAY TIMES, WITH EACH SPECTRUM COMPARED TO THE SPECTRUM AT THE PREVIOUS ALTITUDE

(Computer Printout)

TABLE H- 1

FRACTION CHANGE FROM GHOST POINT TO GH.PT. FROM ALTITUDE A-1 TO A FOR SPECTRA 1

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	0.	0.	0.	0.	0.	0.	0.
2	0.	-0.114	0.129	-0.193	-0.074	-0.024	-0.126
3	0.	-0.123	0.127	-0.229	-0.049	-0.149	-0.086
4	0.	-0.132	-0.005	-0.181	-0.146	-0.068	-0.171
5	0.	-0.289	-0.022	-0.202	-0.220	-0.081	-0.219
6	0.	-0.110	-0.097	-0.213	-0.250	-0.108	-0.172
7	0.	-0.271	-0.171	-0.297	-0.233	-0.173	-0.183
8	0.	-0.278	-0.142	-0.299	-0.265	-0.244	-0.212
9	0.	-0.270	-0.246	-0.273	-0.253	-0.247	-0.244
10	0.	-0.306	-0.171	-0.275	-0.329	-0.217	-0.198
11	0.	-0.345	-0.246	-0.256	-0.367	-0.235	-0.283
12	0.	-0.319	-0.229	-0.283	-0.342	-0.255	-0.228
13	0.	-0.327	-0.228	-0.333	-0.345	-0.233	-0.248
14	0.	-0.330	-0.240	-0.327	-0.322	-0.247	-0.218
15	0.	-0.318	-0.235	-0.315	-0.326	-0.219	-0.209

TABLE H- 2

FRACTION CHANGE FROM GHOST POINT TO GH.PT. FROM ALTITUDE A-1 TO A FOR SPECTRA 2

OUTPUT ENERGY	ALTITUDE						
GROUP	3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	0.	0.	0.	0.	0.	0.	0.
2	0.	-0.114	0.145	-0.200	-0.075	-0.010	-0.126
3	0.	-0.142	0.134	-0.233	-0.055	-0.148	-0.055
4	0.	-0.127	0.005	-0.178	-0.137	-0.070	-0.152
5	0.	-0.312	-0.018	-0.195	-0.216	-0.031	-0.195
6	0.	-0.117	-0.097	-0.211	-0.255	-0.111	-0.155
7	0.	-0.262	-0.155	-0.237	-0.200	-0.158	-0.155
8	0.	-0.279	-0.111	-0.239	-0.269	-0.237	-0.197
9	0.	-0.286	-0.261	-0.280	-0.261	-0.273	-0.214
10	0.	-0.315	-0.190	-0.291	-0.333	-0.238	-0.184
11	0.	-0.363	-0.257	-0.286	-0.379	-0.252	-0.258
12	0.	-0.323	-0.233	-0.298	-0.339	-0.273	-0.219
13	0.	-0.331	-0.226	-0.325	-0.352	-0.233	-0.231
14	0.	-0.334	-0.238	-0.320	-0.328	-0.247	-0.200
15	0.	-0.322	-0.232	-0.308	-0.332	-0.218	-0.191

TABLE H- 3

FRACTION CHANGE FROM GHOST POINT TO GH.PT. FROM ALTITUDE A-1 TO A FOR SPECTRA 3

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	0.	0.	0.	0.	0.	0.	0.
2	0.	-0.112	0.175	-0.214	-0.073	0.005	-0.133
3	0.	-0.158	0.146	-0.246	-0.054	-0.155	-0.026
4	0.	-0.117	0.026	-0.175	-0.130	-0.034	-0.129
5	0.	-0.329	-0.004	-0.190	-0.204	-0.102	-0.162
6	0.	-0.146	-0.115	-0.225	-0.267	-0.135	-0.142
7	0.	-0.252	-0.140	-0.278	-0.154	-0.141	-0.137
8	0.	-0.235	-0.066	-0.285	-0.266	-0.243	-0.184
9	0.	-0.299	-0.269	-0.284	-0.263	-0.300	-0.180
10	0.	-0.325	-0.199	-0.303	-0.331	-0.262	-0.165
11	0.	-0.392	-0.263	-0.313	-0.390	-0.275	-0.233
12	0.	-0.330	-0.240	-0.305	-0.329	-0.310	-0.219
13	0.	-0.342	-0.222	-0.321	-0.359	-0.239	-0.216
14	0.	-0.343	-0.233	-0.316	-0.333	-0.253	-0.183
15	0.	-0.331	-0.228	-0.303	-0.338	-0.224	-0.173

TABLE H- 4

FRACTION CHANGE FROM GHOST POINT TO GH.PT. FROM ALTITUDE A-1 TO A FOR SPECTRA 4

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	0.	0.	0.	0.	0.	0.	0.
2	0.	-0.106	0.209	-0.228	-0.060	0.013	-0.146
3	0.	-0.166	0.167	-0.247	-0.053	-0.159	-0.024
4	0.	-0.109	0.038	-0.177	-0.118	-0.096	-0.126
5	0.	-0.333	0.009	-0.190	-0.138	-0.120	-0.148
6	0.	-0.162	-0.111	-0.235	-0.267	-0.141	-0.145
7	0.	-0.227	-0.124	-0.260	-0.106	-0.118	-0.142
8	0.	-0.280	-0.017	-0.284	-0.239	-0.254	-0.181
9	0.	-0.300	-0.263	-0.280	-0.254	-0.309	-0.169
10	0.	-0.330	-0.190	-0.303	-0.324	-0.270	-0.158
11	0.	-0.391	-0.261	-0.319	-0.391	-0.284	-0.233
12	0.	-0.338	-0.240	-0.313	-0.323	-0.326	-0.227
13	0.	-0.353	-0.219	-0.321	-0.362	-0.247	-0.222
14	0.	-0.351	-0.228	-0.316	-0.333	-0.259	-0.184
15	0.	-0.339	-0.223	-0.303	-0.337	-0.231	-0.175

TABLE H- 5

FRACTION CHANGE FROM GHOST POINT TO GH.PT. FROM ALTITUDE A-1 TO A FOR SPECTRA 5

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	0.	0.	0.	0.	0.	0.	0.
2	0.	-0.106	0.194	-0.219	-0.063	0.016	-0.139
3	0.	-0.172	0.167	-0.249	-0.062	-0.155	-0.004
4	0.	-0.120	0.033	-0.178	-0.126	-0.088	-0.122
5	0.	-0.348	-0.009	-0.188	-0.202	-0.107	-0.146
6	0.	-0.162	-0.122	-0.227	-0.277	-0.138	-0.135
7	0.	-0.222	-0.111	-0.261	-0.097	-0.119	-0.115
8	0.	-0.280	-0.027	-0.275	-0.261	-0.238	-0.173
9	0.	-0.309	-0.274	-0.283	-0.268	-0.312	-0.162
10	0.	-0.332	-0.203	-0.306	-0.336	-0.271	-0.155
11	0.	-0.390	-0.266	-0.319	-0.397	-0.282	-0.220
12	0.	-0.336	-0.247	-0.313	-0.325	-0.330	-0.219
13	0.	-0.356	-0.225	-0.315	-0.374	-0.244	-0.217
14	0.	-0.349	-0.232	-0.310	-0.339	-0.255	-0.171
15	0.	0.	0.	0.	0.	0.	0.

TABLE H- 6

FRACTION CHANGE FROM GHOST POINT TO GH.PT. FROM ALTITUDE A-1 TO A FOR SPECTRA 6

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	0.	0.	0.	0.	0.	0.	0.
2	0.	-0.111	0.127	-0.203	-0.072	-0.003	-0.132
3	0.	-0.162	0.119	-0.243	-0.063	-0.164	-0.017
4	0.	-0.164	0.004	-0.187	-0.168	-0.092	-0.135
5	0.	-0.328	-0.055	-0.202	-0.224	-0.124	-0.156
6	0.	-0.190	-0.183	-0.247	-0.294	-0.170	-0.145
7	0.	-0.263	-0.144	-0.287	-0.153	-0.152	-0.116
8	0.	-0.292	-0.083	-0.285	-0.234	-0.231	-0.180
9	0.	-0.309	-0.282	-0.290	-0.258	-0.308	-0.168
10	0.	-0.329	-0.215	-0.310	-0.337	-0.265	-0.162
11	0.	-0.384	-0.271	-0.318	-0.390	-0.275	-0.221
12	0.	-0.331	-0.253	-0.310	-0.323	-0.318	-0.212
13	0.	-0.351	-0.233	-0.318	-0.368	-0.241	-0.216
14	0.	-0.343	-0.239	-0.314	-0.332	-0.251	-0.170
15	0.	0.	0.	0.	0.	0.	0.

TABLE H- 7

FRACTION CHANGE FROM GHOST POINT TO GH.PT. FROM ALTITUDE A-1 TO A FOR SPECTRA 7

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	0.	0.	0.	0.	0.	0.	0.
2	0.	-0.119	0.062	-0.198	-0.061	-0.031	-0.140
3	0.	-0.160	0.069	-0.233	-0.068	-0.173	-0.059
4	0.	-0.201	-0.033	-0.202	-0.196	-0.100	-0.166
5	0.	-0.296	-0.099	-0.224	-0.227	-0.154	-0.173
6	0.	-0.217	-0.233	-0.274	-0.298	-0.194	-0.171
7	0.	-0.276	-0.172	-0.295	-0.189	-0.166	-0.146
8	0.	-0.288	-0.125	-0.298	-0.254	-0.233	-0.194
9	0.	-0.292	-0.269	-0.279	-0.241	-0.278	-0.187
10	0.	-0.318	-0.196	-0.290	-0.322	-0.233	-0.168
11	0.	-0.363	-0.266	-0.292	-0.364	-0.251	-0.252
12	0.	-0.330	-0.251	-0.289	-0.325	-0.276	-0.201
13	0.	-0.347	-0.239	-0.324	-0.346	-0.238	-0.230
14	0.	-0.339	-0.245	-0.320	-0.309	-0.248	-0.184
15	0.	0.	0.	0.	0.	0.	0.

TABLE H- 8

FRACTION CHANGE FROM GHOST POINT TO GH.PT. FROM ALTITUDE A-1 TO A FOR SPECTRA 8

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	0.	0.	0.	0.	0.	0.	0.
2	0.	-0.127	0.043	-0.196	-0.046	-0.043	-0.142
3	0.	-0.170	0.065	-0.236	-0.086	-0.159	-0.076
4	0.	-0.193	-0.054	-0.208	-0.176	-0.082	-0.186
5	0.	-0.300	-0.112	-0.225	-0.221	-0.119	-0.198
6	0.	-0.192	-0.209	-0.250	-0.277	-0.143	-0.173
7	0.	-0.239	-0.148	-0.273	-0.162	-0.144	-0.136
8	0.	-0.251	-0.123	-0.279	-0.230	-0.208	-0.192
9	0.	-0.279	-0.257	-0.265	-0.233	-0.245	-0.206
10	0.	-0.307	-0.178	-0.265	-0.324	-0.196	-0.178
11	0.	-0.345	-0.255	-0.250	-0.347	-0.219	-0.277
12	0.	-0.324	-0.249	-0.272	-0.325	-0.247	-0.198
13	0.	-0.339	-0.242	-0.322	-0.335	-0.228	-0.238
14	0.	-0.332	-0.248	-0.318	-0.298	-0.239	-0.193
15	0.	0.	0.	0.	0.	0.	0.

TABLE H- 9

FRACTION CHANGE FROM GHOST POINT TO GH.PT. FROM ALTITUDE A-1 TO A FOR SPECTRA 9

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	0.	0.	0.	0.	0.	0.	0.
2	0.	-0.129	0.053	-0.198	-0.046	-0.044	-0.137
3	0.	-0.174	0.073	-0.245	-0.096	-0.145	-0.078
4	0.	-0.191	-0.060	-0.211	-0.159	-0.072	-0.185
5	0.	-0.311	-0.108	-0.226	-0.224	-0.088	-0.207
6	0.	-0.142	-0.145	-0.217	-0.251	-0.091	-0.159
7	0.	-0.219	-0.133	-0.265	-0.146	-0.131	-0.130
8	0.	-0.238	-0.108	-0.273	-0.226	-0.202	-0.190
9	0.	-0.274	-0.256	-0.265	-0.236	-0.244	-0.205
10	0.	-0.302	-0.178	-0.267	-0.325	-0.195	-0.178
11	0.	-0.341	-0.253	-0.253	-0.350	-0.217	-0.275
12	0.	-0.318	-0.247	-0.272	-0.327	-0.245	-0.199
13	0.	-0.334	-0.239	-0.321	-0.337	-0.224	-0.237
14	0.	-0.326	-0.245	-0.316	-0.301	-0.235	-0.193
15	0.	0.	0.	0.	0.	0.	0.

TABLE H-10

FRACTION CHANGE FROM GHOST POINT TO GH.PT. FROM ALTITUDE A-1 TO A FOR SPECTRA 10

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	0.	0.	0.	0.	0.	0.	0.
2	0.	-0.119	0.097	-0.210	-0.049	-0.030	-0.139
3	0.	-0.131	0.090	-0.255	-0.096	-0.145	-0.070
4	0.	-0.201	-0.054	-0.217	-0.163	-0.094	-0.168
5	0.	-0.319	-0.102	-0.237	-0.228	-0.118	-0.179
6	0.	-0.119	-0.089	-0.220	-0.241	-0.088	-0.138
7	0.	-0.191	-0.119	-0.253	-0.103	-0.100	-0.132
8	0.	-0.238	-0.038	-0.280	-0.208	-0.226	-0.174
9	0.	-0.273	-0.253	-0.270	-0.235	-0.269	-0.174
10	0.	-0.305	-0.176	-0.285	-0.316	-0.227	-0.154
11	0.	-0.364	-0.258	-0.298	-0.368	-0.250	-0.246
12	0.	-0.322	-0.241	-0.291	-0.325	-0.276	-0.202
13	0.	-0.339	-0.228	-0.323	-0.349	-0.232	-0.227
14	0.	-0.332	-0.235	-0.319	-0.313	-0.242	-0.182
15	0.	0.	0.	0.	0.	0.	0.

TABLE H-11

FRACTION CHANGE FROM GHOST POINT TO GH.PT. FROM ALTITUDE A-1 TO A FOR SPECTRA 11

OUTPUT ENERGY GROUP	ALTITUDE 3 FT	10 FT	25 FT	50 FT	100 FT	150 FT	200 FT
1	0.	0.	0.	0.	0.	0.	0.
2	0.	-0.106	0.212	-0.253	-0.052	0.002	-0.153
3	0.	-0.196	0.120	-0.273	-0.077	-0.155	-0.053
4	0.	-0.184	-0.016	-0.215	-0.138	-0.134	-0.121
5	0.	-0.324	-0.041	-0.239	-0.190	-0.173	-0.108
6	0.	-0.095	0.010	-0.244	-0.215	-0.106	-0.111
7	0.	-0.111	-0.109	-0.213	0.016	-0.039	-0.157
8	0.	-0.243	0.132	-0.297	-0.151	-0.282	-0.153
9	0.	-0.267	-0.239	-0.271	-0.215	-0.310	-0.119
10	0.	-0.318	-0.159	-0.307	-0.294	-0.275	-0.118
11	0.	-0.392	-0.248	-0.336	-0.385	-0.292	-0.216
12	0.	-0.335	-0.230	-0.334	-0.303	-0.347	-0.227
13	0.	-0.353	-0.204	-0.327	-0.358	-0.250	-0.212
14	0.	-0.349	-0.212	-0.322	-0.325	-0.262	-0.170
15	0.	0.	0.	0.	0.	0.	0.

REFERENCES

1. De Vries, T. W., Fallout Radiation Energy Distribution as a Function of Altitude, General Dynamics/Fort Worth Report FZK-187, 15 July 1964.

2. Grodstein, G. W., Gamma-Ray Attenuation Coefficients from 10 Kev to 100 Mev, National Bureau of Standards Circular 583, April 1957.

3. Hodgman, C. D., Handbook of Chemistry and Physics, 32nd ed., Chemical Rubber Publishing Company, Cleveland, pp. 2805 and 2806.

4. Nelms, A. T., and J. W. Cooper, "U-235 Fission Product Decay Spectra at Various Times after Fission," Health Physics 1 (1959), 427.

5. Glendenin, L. E., C. D. Coryell, and R. R. Edwards, "Distribution of Nuclear Charge in Fission," Radiochemical Studies: The Fission Products, Book 1 (C. D. Coryell and N. Sugarman, eds.) National Nuclear Energy Series, McGraw-Hill, New York, 1951, p. 489.

6. Henderson, B. J., Conversion of Neutron or Gamma-Ray Flux to Absorbed Dose Rate, General Electric Report XDC 59-8-179, 14 August 1959.

7. Design and Review of Structures for Protection from Fallout Gamma Radiation, Office of Civil Defense Report PM-100-1, February 1965.

Unclassified
Security Classification

DOCUMENT CONTROL DATA - R&D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Nuclear Aerospace Research Facility Fort Worth Division of General Dynamics Fort Worth, Texas	2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP

3. REPORT TITLE
EXPANSION OF FALLOUT-RADIATION NUMBER-SPECTRA CALCULATIONS TO LOW ALTITUDE

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Final Report (20 September 1965 - 20 April 1966)

5. AUTHOR(S) (Last name, first name, initial)
McDermed, O. L., and De Vries, T. W.

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
1 July 1966	142	7

8a. CONTRACT OR GRANT NO. USNRDL Contract No.228-(62479)69007 OCD Work Unit 2111I	9a. ORIGINATOR'S REPORT NUMBER(S) FZK-291
c. d.	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)

10. AVAILABILITY/LIMITATION NOTICES
Distribution of this document is unlimited.

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	Office of the Civil Defense Office of the Secretary of the Army Washington, D. C. 20310

13. ABSTRACT

Gamma-ray number and dose-rate spectra in the air above a smooth, quasi-infinite ground uniformly covered with fallout fission products are calculated. The spectra are calculated for 11 decay times, from 1.12 hours to 97.3 days, and at 7 altitudes, from 3 ft to 200 ft. The spectra are analyzed for the effects of altitude and decay time on spectral shape, with trends illustrated by computer tabulations and selected graphs.

Results show that the spectra soften with increasing altitude and that they soften with decay time for about 2 days, become slightly harder for about 3 weeks, then resume softening. Reduction of total dose rate with altitude is nearly independent of decay time (below 400 feet). A related study, to determine the effects of ground roughness, is recommended.

DD FORM 1 JAN 64 1473

Unclassified
Security Classification

Unclassified

Security Classification

14. KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
Radioactive fallout Fallout energy spectra Fallout dose rates Radiation hazards						

INSTRUCTIONS

1. ORIGINATING ACTIVITY: Enter the name and address of the contractor, subcontractor, grantee, Department of Defense activity or other organization *(corporate author)* issuing the report.

2a. REPORT SECURITY CLASSIFICATION: Enter the overall security classification of the report. Indicate whether "Restricted Data" is included. Marking is to be in accordance with appropriate security regulations.

2b. GROUP: Automatic downgrading is specified in DoD Directive 5200.10 and Armed Forces Industrial Manual. Enter the group number. Also, when applicable, show that optional markings have been used for Group 3 and Group 4 as authorized.

3. REPORT TITLE: Enter the complete report title in all capital letters. Titles in all cases should be unclassified. If a meaningful title cannot be selected without classification, show title classification in all capitals in parenthesis immediately following the title.

4. DESCRIPTIVE NOTES: If appropriate, enter the type of report, e.g., interim, progress, summary, annual, or final. Give the inclusive dates when a specific reporting period is covered.

5. AUTHOR(S): Enter the name(s) of author(s) as shown on or in the report. Enter last name, first name, middle initial. If military, show rank and branch of service. The name of the principal author is an absolute minimum requirement.

6. REPORT DATE: Enter the date of the report as day, month, year; or month, year. If more than one date appears on the report, use date of publication.

7a. TOTAL NUMBER OF PAGES: The total page count should follow normal pagination procedures, i.e., enter the number of pages containing information.

7b. NUMBER OF REFERENCES: Enter the total number of references cited in the report.

8a. CONTRACT OR GRANT NUMBER: If appropriate, enter the applicable number of the contract or grant under which the report was written.

8b, 8c, & 8d. PROJECT NUMBER: Enter the appropriate military department identification, such as project number, subproject number, system numbers, task number, etc.

9a. ORIGINATOR'S REPORT NUMBER(S): Enter the official report number by which the document will be identified and controlled by the originating activity. This number must be unique to this report.

9b. OTHER REPORT NUMBER(S): If the report has been assigned any other report numbers *(either by the originator or by the sponsor)*, also enter this number(s).

10. AVAILABILITY/LIMITATION NOTICES: Enter any limitations on further dissemination of the report, other than those imposed by security classification, using standard statements such as:

(1) "Qualified requesters may obtain copies of this report from DDC."

(2) "Foreign announcement and dissemination of this report by DDC is not authorized."

(3) "U. S. Government agencies may obtain copies of this report directly from DDC. Other qualified DDC users shall request through ______________."

(4) "U. S. military agencies may obtain copies of this report directly from DDC. Other qualified users shall request through ______________."

(5) "All distribution of this report is controlled. Qualified DDC users shall request through ______________."

If the report has been furnished to the Office of Technical Services, Department of Commerce, for sale to the public, indicate this fact and enter the price, if known.

11. SUPPLEMENTARY NOTES: Use for additional explanatory notes.

12. SPONSORING MILITARY ACTIVITY: Enter the name of the departmental project office or laboratory sponsoring *(paying for)* the research and development. Include address.

13. ABSTRACT: Enter an abstract giving a brief and factual summary of the document indicative of the report, even though it may also appear elsewhere in the body of the technical report. If additional space is required, a continuation sheet shall be attached.

It is highly desirable that the abstract of classified reports be unclassified. Each paragraph of the abstract shall end with an indication of the military security classification of the information in the paragraph, represented as *(TS), (S), (C), or (U)*.

There is no limitation on the length of the abstract. However, the suggested length is from 150 to 225 words.

14. KEY WORDS: Key words are technically meaningful terms or short phrases that characterize a report and may be used as index entries for cataloging the report. Key words must be selected so that no security classification is required. Identifiers, such as equipment model designation, trade name, military project code name, geographic location, may be used as key words but will be followed by an indication of technical context. The assignment of links, rules, and weights is optional.

Unclassified

Security Classification